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SCAPHITIDS FROM THE UPPER CAMPANIAN–LOWER MAASTRICHTIAN BEARPAW FORMATION OF THE WESTERN INTERIOR OF CANADA

A.C. RICCARDI

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Preface

In this report the range of morphological variation of a collection of scaphitids (ammonites-extinct marine molluscs) from the Bearpaw Formation of Western Canada is studied and the fauna are illustrated. The taxonomic status of other North American material similar to the Bearpaw material is clarified and comparisons are drawn between scaphitids of similar age from Europe and Canada.

The Bearpaw Formation makes up most of the bedrock that outcrops in southeastern Alberta and southwestern Saskatchewan. Marine, silty clay and sand predominate and the formation appears to have been deposited under shallow water conditions near the shores of a great inland sea that existed in Late Cretaceous time.

Paleontological studies such as this provide data used in correlating rock units as well as giving information useful in determining the environments under which the rocks were deposited. It is from such data that geological maps are constructed and basin analyses are made and these in turn are of great importance in assessing hydrocarbon resources.

R.A. Price
Director General
Geological Survey of Canada

Ottawa, May 1982

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SCAPHITIDS FROM THE UPPER CAMPANIAN-LOWER MAASTRICHTIAN BEARPAW FORMATION OF THE WESTERN INTERIOR OF CANADA

Abstract

The scaphitids from the Bearpaw Formation of Canada are revised taxonomically and chronologically, based on the reexamination of all available material, including all type specimens of previously described species. The following species, belonging to the genera ***Haploscaphites*** *Nowak,* ***Jeletzkytes*** *gen. nov.,* ***Rhaeboceras*** *and* ***Ponteixites*** *are described and figured:* ***H. landesi*** *sp. nov., H. sp. α, H. sp. β, H. sp. indet.;* ***J. nodosus*** *(Owen),* ***J. aff. nodosus,*** ***J. cf. nodosus,*** ***J. furnivali*** *sp. nov.,* ***J. cf. crassus*** *(Coryell and Salmon),* ***J. cf. brevis*** *(Meek)* ♀ *&* ♂*,* ***J. aff. brevis*** ♀*,* ***J. criptonodosus*** *sp. nov.* ♀ *&* *cf.* ♂*,* ***Rhaeboceras halli*** *(Meek),* ***R. aff. halli,*** ***R. albertense*** *(Warren),* ***R. subglobosus*** *(Whiteaves),* ***Ponteixites robustus*** *Warren,* ***P. gracilis*** *Warren and* ***P.?*** *sp. nov. Sexual dimorphism is indicated or suggested for some of the species described. The affinities with Eurasian scaphitids are discussed, and it is concluded that most genera and all species appear to be endemic to the Western Interior of North America. Some baculitids, occurring in the same assemblages are also illustrated to support scaphitid stratigraphic occurrences. On that basis it is shown: 1) that scaphitids are rare from the* ***Didymoceras nebrascense*** *to the* ***Baculites compressus*** *Zones; 2) that the* ***B. cuneatus,*** ***B. reesidei*** *and* ***B. jenseni*** *Zones appear to be the most widespread, and are mainly characterized by* ***Rhaeboceras*** *spp.; 3) that the* ***B. eliasi*** *and* ***B. baculus*** *Zones include representatives of the new genus* ***Jeletzkytes*** *with incipient multituberculate ornament, as well as* ***Ponteixites*** *spp.; 4) that there is no evidence of scaphitids from the* ***B. grandis*** *Zone in the collections available to the author.*

Résumé

La taxonomie et la chronologie des scaphitidés de la formation de Bearpaw du Canada ont été révisées à la suite d'une nouvelle étude de tout le matériel disponible, y compris les holotypes d'espèces déjà décrites. Les espèces suivantes appartenant aux genres ***Haploscaphites*** *Nowak,* ***Jeletzkytes*** *gen. nov.,* ***Rhaeboceras*** *et* ***Ponteixites*** *sont décrites et illustrées:* ***H. landesi*** *sp. nov., H. sp. α, H. sp. β, H. sp. indet.;* ***J. nodosus*** *(Owen),* ***J. aff. nodosus,*** ***J. cf. nodosus,*** ***J. furnivali*** *sp. nov.,* ***J. cf. crassus*** *(Coryell et Salmon),* ***J. cf. brevis*** *(Meek)* ♀ *&* ♂*,* ***J. aff. brevis*** ♀*,* ***J. criptonodosus*** *sp. nov.* ♀ *&* *cf.* ♂ ***Rhaeboceras halli*** *(Meek),* ***R. aff. halli,*** ***R. albertense*** *(Warren),* ***R. subglobosus*** *(Whiteaves),* ***Ponteixites robustus*** *Warren,* ***P. gracilis*** *Warren et* ***P.?*** *sp. nov. Le dimorphisme sexuel est reconnu ou suggéré chez certaines espèces décrites. L'auteur discute des affinités avec les scaphitidés eurasiens et conclu que la plupart des genres et toutes les espèces sembleraient être endémiques à l'intérieur occidental de l'Amérique du Nord. Quelques baculitidés ont été identifiés dans les mêmes assemblages et sont également illustrés à l'appui des venues stratigraphiques des scaphitidés. L'auteur montre donc: 1) que les scaphitidés sont rares de la zone de* ***Didymoceras nebrascense*** *à celle de* ***Baculites compressus;*** *2) que les zones de* ***B. cuneatus,*** ***B. reesidei*** *et* ***B. jenseni*** *semblent être les plus répandues et sont caractérisées principalement par des espèces du genre* ***Rhaeboceras;*** *3) que les zones de* ***B. eliasi*** *et* ***B. baculus*** *contiennent des représentants du nouveau genre* ***Jeletzkytes,*** *qui montre un commencement d'ornementation multituberculée, et d'espèces du genre* ***Ponteixites;*** *4) qu'aucun scaphitidé n'a été identifié dans les collections de fossiles de la zone de* ***B. grandis*** *disponible à l'auteur.*

INTRODUCTION

The scaphitids of the Bearpaw Formation are mostly known from several works published in United States at the end of the past century and beginning of the present (see Owen, 1852; Meek, 1876; Smith, 1905; Reeside, 1927a; Elias, 1933; Coryell and Salmon, 1934).

In Canada they were first figured by Meek (in Hind, 1859), although the first systematic treatment was given by Whiteaves (1885). Since that time, however, almost nothing has been added, except for Dowling's (1917) refiguring of type material, until Warren (1934) introduced the genus **Ponteixites,** and Williams (1930) and Landes (in Russell and Landes, 1940) described some new material.

In subsequent years, reference to the Bearpaw Formation scaphitids has been made in several publications (see Jeletzky, in Cobban and Reeside, 1952; Birkelund, 1965; Jeletzky, 1968; Caldwell, 1968) and some new specimens have been figured by Jeletzky (1970). Most of these papers, however, have stressed the need for a general review of this group of ammonoids. That necessity was already apparent to Reeside (1927a), Warren (1934), and prompted the (only partly published) taxonomic studies of Warren (1934), Brown (1943) and Jeletzky (1962a, 1968).

Because of the preliminary nature of the above mentioned research, much remains to be done. The first objective of this study has been to study and illustrate the range of morphological variation of the Canadian scaphitids and to clarify the taxonomic status of other North American scaphitid species related to the Canadian Bearpaw material. The scaphitids of similar age found in Europe are then compared to the Canadian examples.

As most of the available Canadian material is derived from the collections of several workers assembled over the past century, exact stratigraphic, and sometimes geographic, information is not always known. The study of this material was also complicated by the fact that in many cases the scaphitids and baculitids originally found in the same fossil assemblage were later separated in the course of successive laboratory identifications and studies. Furthermore, part of the most important collection, that made by G.M. Furnival in the Cypress Hills, was accidentally overturned and separated from the labels before it could be catalogued (J.A. Jeletzky, personal communication).

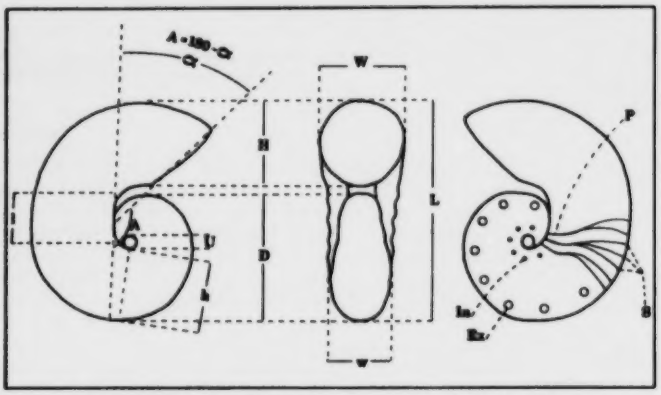
Nonetheless, the paleontological collections of the GSC include a fair number of rather well preserved scaphitids from the Bearpaw Formation, the stratigraphy and geographic location of which is suitably documented. On that basis, and with the aid of the baculitid collections and all other existing information it has been possible to carry out this study.

The author wishes to acknowledge the classification, preparation and photography of most of the scaphitid material prior to this study by P.S. Warren, R. Brown and J.A. Jeletzky. The author was also able to study briefly the relatively much larger scaphitid collection preserved in the U.S. Geological Survey. This collection made and arranged by W.A. Cobban from beds dated in terms of the standard Baculites zones recognized in the Western Interior of the United States, provided stratigraphic constraints that facilitated taxonomic interpretation of some Canadian scaphitids treated in this paper. However, the stratigraphic control of morphological variation of a number of scaphitids remains either incomplete or deficient. As a result, open nomenclature is used for all such specimens rather than attempting to erect new species because of their morphological distinctions from species whose range has yet to be documented on the basis of sufficient topotype material. The morphological variety of the Canadian scaphitid material could then be adequately described. Consequently, biostratigraphic, biogeographic and phylogenetic considerations have been kept to a minimum in order that accurate conclusions regarding the species may be formulated. Despite such constraints, this description of the scaphitids from the Bearpaw Formation of Canada will add substantially to the knowledge of this group. Also, it will provide the basis for comprehensive and detailed study by the U.S.G.S. workers of abundant contemporary scaphitid material from the Western Interior of the United States.

Measurements

The measurements of the types and figured specimens as listed in the tables and illustrated by Figure 1 were all taken by conventional methods on the internal moulds. They all are in mm.

- L = maximum length of uncoiled specimens;
- D = shell diameter of "normally" coiled whorls, usually corresponding to the phragmocone;
- U = umbilical diameter;
- h = whorl height at a given diameter of phragmocone (= D) in specimens with deflected body chamber, from umbilical seam to venter in plane of coiling;
- w = whorl width at given D perpendicular to plane of coiling;
- l = length of shaft measured along the straight inner margin;
- H = whorl height at the end of the deflected body chamber or at given D in species "normally" coiled;
- W = whorl width at the end of the deflected body chamber or at given D in species "normally" coiled;
- A = apertural angle of specimens with deflected body chamber, measured with respect to the longest axis of the shell;
- P = number of primary ribs in one whorl;
- S = number of secondary ribs in one whorl;
- In = number of nodes on the lower or middle part of the flanks in one whorl;
- Ex = number of ventrolateral nodes in one whorl.



Text-figure 1. Critical measurements of Scaphites.

Some specimens were measured at different diameters, representing morphogeny, at phragmocone (phrag.), body chamber (b. ch.) as indicated.

Repositories

The figured specimens are deposited in the following collections under the catalogue numbers listed in the text and plate explanations:

- AMNH Department of Fossil Invertebrates, The American Museum of Natural History, Central Park West at 79th Street, New York 24, N.Y., U.S.A.
- BMNH British Museum (Natural History), Cromwell Road, London, S.W. 7, England.
- F.M. Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, Illinois 60605, U.S.A.
- GSC Geological Survey of Canada, 601 Booth St., Ottawa, Ont., Canada K1A 0E8.
- GSM Institute of Geological Sciences, Exhibition Rd., London S.W. 7, 2DE, England.
- MNHUB Museum fur Naturkunde, Humboldt Universitat, Invalidenstrasse 43, Berlin, D.D.R.
- NLB Niedersachsisches Landesamt fur Bodenforschung, 3 Hannover 51, Stillweg 2, D.F.R.
- U.A. Department of Geology, University of Alberta, Edmonton, Alberta, Canada T6G 2E1.
- USNM U.S. Geological Survey, U.S. National Museum, Washington D.C., U.S.A.

Acknowledgments

This project was started at the suggestion of J.A. Jeletzky who provided valuable help, advice and encouragement. He also provided plaster casts of North American and European scaphitids, bibliographic data, photographs, unpublished notes and other information assembled during a study of Canadian Bearpaw scaphitids which he later abandoned.

W.A. Cobban of the U.S. Geological Survey at Denver, and C.R. Stelck of the University of Alberta, kindly allowed access to their collections, W.G.E. Caldwell of the University of Saskatchewan offered help and advice.

For the lending of types and other specimens and for the gift of plastotypes the author is indebted to the following: R.V. Best of the University of British Columbia; N. Eldredge and Ms. J. Golden of the American Museum of Natural History, N.Y., U.S.A.; J. Helms of the Museum für Naturkunde, Humboldt Universitat, Berlin, D.D.R.; Fr. Schmid of the Niedersachsisches Landesamt fur Bodenforschung, Hannover, D.F.R.; C.R. Stelck and B. Jones of the University of Alberta, Canada; L.A. van der Tuuk, Flamingo straat 20, 3582 SX Utrecht, The Netherlands; K. Wise and M.H. Nitecki of the Field Museum of Natural History, Chicago, U.S.A.

The author was introduced to the field stratigraphy of the Upper Cretaceous of the Western Interior by D.H. McNeil, A.R. Sweet and N.S. Ioannides, of the Calgary division of the GSC.

The contributions of the technical and support staff of the GSC are also gratefully acknowledged, particularly the assistance of J.I. White, who prepared the photographs used in this paper, G. Martin, who did the technical preparation, and K. Vincent who is responsible for the bulk of technical editing of the manuscript.

STRATIGRAPHIC SUMMARY

The Bearpaw Formation was named by Stanton and Hatcher (1903, p. 211-212) for its sections in the Bearpaw Mountains of north-central Montana. The formation was then traced northward into the adjacent region of Southern Canada (Stanton and Hatcher, 1905).

The formation comprises most of the outcropping bedrock in much of southeastern Alberta and southwestern Saskatchewan and its general features have been dealt with by many authors, e.g. Dowling (1917), Williams and Dyer (1930), Fraser et al. (1935), Russell and Landes (1940), Russell (1950), Furnival (1950), Loranger and Gleddie (1953), Lines (1963).

More detailed studies, mainly of biostratigraphic character, have been carried out by Caldwell (1968), Jeletzky (1968), North and Caldwell (1970, 1975), Caldwell et al. (1978), and the reader is directed to these publications for supplementary information.

The Bearpaw Formation consists of marine silty clays and sands and ranges from less than 30.5 m (100 ft) near the Rocky Mountains foothills to as much as 365.8 m (1,200 ft) in southeastern Alberta and Saskatchewan. In the latter area it overlies the nonmarine Oldman and Belly River Formations and grades upwards into the marine sandstones of the Eastend Formation. In the more westerly areas it passes into the Judith River Formation below and the Blood Reserve and St. Mary River Formations above, most of which represent eastward thinning wedges of nonmarine sediments.

Thus, the Bearpaw Formation appears to be part of a transgressive-regressive sequence deposited in the Western Interior sea during the later part of Late Cretaceous times. Sedimentological and paleontological information suggests that the Bearpaw Formation was deposited under shallow water conditions, adjacent to the western shore of the Western Interior sea.

On the basis of stratigraphic studies conducted in the Cypress Hills and the South Saskatchewan River valley, the Bearpaw Formation was divided into two different sets of members (see Forester et al., 1977), which were dated using the molluscan zonal scheme devised by Cobban (see Obradovich and Cobban, 1975) for the Western Interior of the United States. This stratigraphic scheme supercedes the earlier attempts undertaken by Warren (in Fraser et al., 1935), Russell and Landes (1940), Jeletzky (1968) and Caldwell (1968).

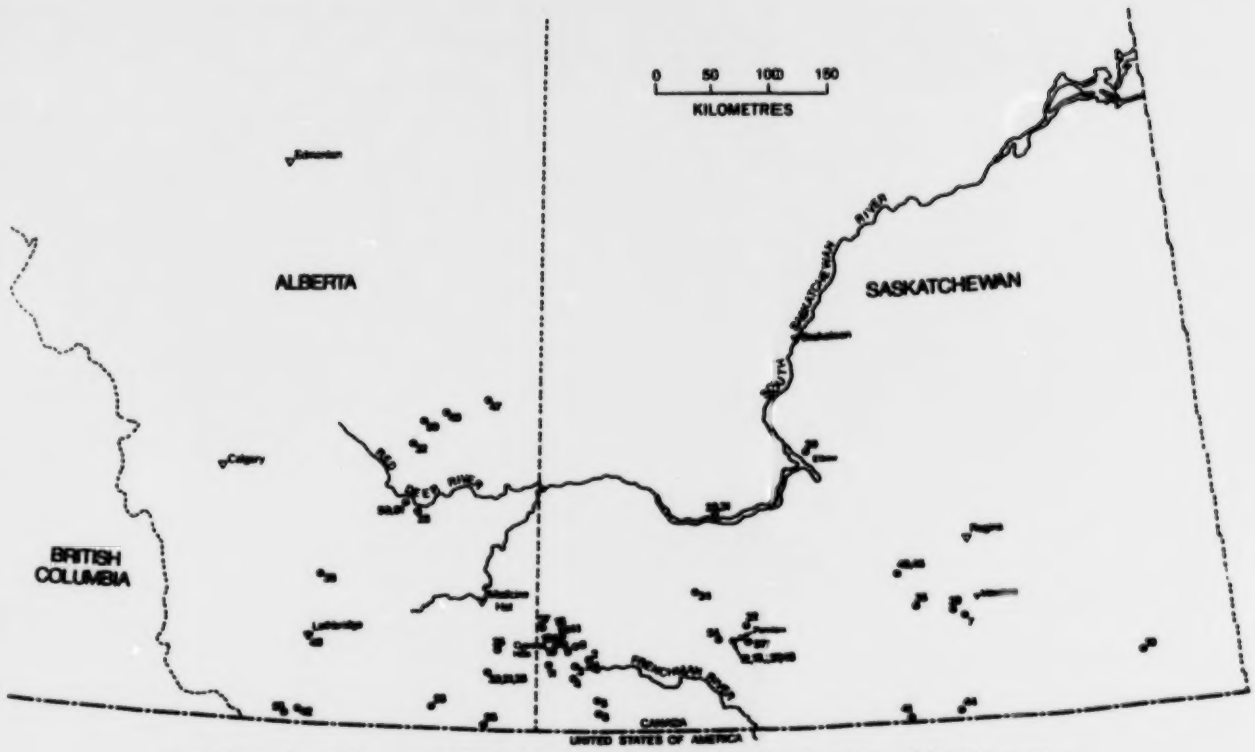
The Bearpaw Formation is best exposed in southwestern Saskatchewan and southeastern Alberta, especially on the flanks of the Cypress Hills and in the Frenchman River valley (see Fig. 2). In that area it is almost completely exposed in a series of sections.

The invertebrate fauna of the Bearpaw Formation consists mainly of Foraminifera and Mollusca. Most molluscs were listed by Warren (in Fraser et al., 1935) and they have been described, listed and discussed by Whiteaves (1885, 1889), Dowling (1917), Landes (in Russell and Landes, 1940), Warren (1931), Douglas (1942) and Jeletzky (1962a,b, 1968, 1970). Foraminifera have been mostly dealt with by Wickenden (1932), Loranger and Gleddie (1953), North and Caldwell (1970, 1975), Given and Wall (1971) and Caldwell et al. (1978). The latter authors have also correlated the foraminifera and molluscan zonal schemes.

FOSSIL LOCALITIES

(Numbers 1-60 refer to Index Map I)

1. GSC loc. 10374. Belanger Member, north side of Frenchman River, just west of road from Canton's ranch to Robsart, Sec. 14, Tp. 6, Rge. 25, W3rd., Saskatchewan. Coll. G.M. Furnival, 1940.
2. GSC loc. 10375-10377. Belanger Member, talus 1/4 mile north of junction of Davis Creek and Frenchman River, 200 yards east of cabin. Coll. G.M. Furnival, 1940.
3. GSC loc. 10395. Belanger Member, c. 92'-93' below top of Bearpaw Formation, north side of Cypress Lake, Sec. 14, Tp. 6, Rge. 27, W3rd., Saskatchewan. Coll. G.M. Furnival, 1940.
4. GSC loc. 10398. West of Dam Coulée, about 1 mile west of HW 21, south side of Cypress Lake, Saskatchewan. Coll. G.M. Furnival, 1940.
5. GSC loc. 10407. Belanger Member, Cypress Hills, NE Sec. 16, Tp. 3, Rge. 25, W3rd., Saskatchewan. Coll. G.M. Furnival, 1940.
6. GSC loc. 10416. Belanger Member, NW of Old Man on His Back Plateau, Cypress Hills, Sec. 16, Tp. 3, Rge. 25, W3rd., Saskatchewan. Coll. G.M. Furnival.
7. GSC loc. 10437. SW of Milestone, SE 1/4, Tp. 10, Rge. 20, W2nd., Saskatchewan. Coll. R. Graham, 1936.
8. GSC loc. 16313. About 500'-600' below top of Bearpaw Formation, McShane Creek, Cypress Hills, Sec. 25, Tp. 9, Rge. 27, W3rd., Saskatchewan. Coll. G.M. Furnival, 1941.
9. GSC loc. 16316. About 600' below top of Bearpaw Formation, SE 1/4, Sec. 3, Tp. 10, Rge. 28, W3rd., Saskatchewan. Coll. G.M. Furnival, 1941.
10. GSC loc. 16321. Cypress Hills, NW 1/4, Sec. 18, Tp. 9, Rge. 28, W3rd., Saskatchewan.
11. GSC loc. 16325. Belanger Member, Battle Creek, Sec. 10, Tp. 7, Rge. 29, W3rd., Saskatchewan. Coll. G.M. Furnival, 1941.
12. GSC loc. 16326. Ponteix, Saskatchewan. Coll. P.S. Warren, 1930.
13. GSC loc. 16327. Ponteix, west of Tilney, Saskatchewan. P.S. Warren, 1930.
14. GSC loc. 16328. Cypress Hills, Sec. 18, Tp. 10, Rge. 28, W3rd., G.M. Furnival, 1941.



Text-figure 2. Index map of Saskatchewan and Alberta showing locations of fossil localities.

15. GSC loc. 16330. Cypress Hills, 1/4, Sec. 7, Tp. 10, Rge. 28, W3rd., Saskatchewan. Coll. G.M. Furnival, 1941.
16. GSC loc. 16331. Cypress Hills, SE 1/4, Sec. 17, Tp. 10, Rge. 28, W3rd., Saskatchewan. G.M. Furnival, 1941.
17. GSC loc. 16334. Frenchman River, Saskatchewan. Coll. F.H. McLearn, 1928.
18. GSC loc. 16337. Frenchman River, south bank, about 1 mile below McGuines ranch. Coll. F.H. McLearn, 1928.
19. GSC loc. 16338. ?Shaft sunk at Lampman, Saskatchewan. Coll. D.B. Dowling., 1920.
20. GSC loc. 16395. About 300' above base of Bearpaw Formation, Manyberries section, Sec. 30, Tp. 5, Rge. 4, W4th., Alberta. Coll. R.W. Landes.
21. GSC loc. 16396. About 500 ft. above base of Bearpaw Formation, Manyberries section, Sec. 30, Tp. 5, Rge. 4, W4th., Alberta. Coll. R.W. Landes.
22. GSC loc. 16457. Berry Creek, Sec. 11, Tp. 27, Rge. 12, W4th. Coll. L.S. Russell, 1931.
23. GSC loc. 16459. SW 1/4, Sec. 20, Tp. 21, Rge. 11, W4th., Alberta. Coll. J.S. Stewart, 1940.
24. GSC loc. 17882. ?French, Saskatchewan. Coll. P.S. Warren, 1928.
25. GSC loc. 17925. Medicine Lodge Coulée, SE 1/4, Sec. 7, Tp. 8, Rge. 3, W4th. Coll. R.W. Landes, 1940.
26. GSC loc. 19429. About 150 feet above Bentonite No. 8, Manyberries section, Cypress Hills, Alberta. Coll. R.W. Landes.
27. GSC loc. 37742. Ponteix, Saskatchewan. ?Coll. P.S. Warren, 1930.
28. GSC loc. 97988. South Saskatchewan River, opposite mouth Swift Current Creek, Saskatchewan. Coll. T.C. Weston, 1889.
29. GSC loc. 97989. West of Milestone, Sec. 28, Tp. 11, Rge. 21, W2nd., Saskatchewan.
30. GSC loc. 97990. Elbow of Saskatchewan. Coll. J. Macoun, 1879.
31. GSC loc. 97991. South Saskatchewan River, opposite mouth of Swift Current Creek, Saskatchewan. Coll. R.G. McConnell, 1882.
32. GSC loc. 97992. Old Wives Creek, Tp. 10, Rge. 11, W3rd., Saskatchewan. Coll. R.G. McConnell, 1884.
33. GSC loc. 97993. (?)Frenchman River, Saskatchewan. Coll. P.S. Warren, 1928.
34. GSC loc. 97994. Swift Current Creek, NE Sec. 35, Tp. 13, Rge. 15, W3rd., Saskatchewan. Coll. P.S. Warren.
35. GSC loc. 97995. Dirt Hills, south of Regina, Saskatchewan. Coll. A. Mowat, 1892.
36. GSC loc. 97996. Cypress Hills Map Area. Exact locality and level unknown. Coll. G.M. Furnival.
37. GSC loc. 97997. Box Elder Creek, south branch, Saskatchewan, Sec. 30, Tp. 10, Rge. 29, W3rd. Coll. W.S. Dyer.

38. GSC loc. 97998. Travers reservoir, near Vulcan, at opposite end of lake from Little Bow Park, Alberta. Coll. Mrs. P. James, 1980.

39. GSC loc. 97999. Marklee, south of Elbow, Saskatchewan. Coll. J.A. Allan, 1917.

40. GSC loc. 98000. White Mud River, Coll. R.G. McConnell, 1884.

41. GSC loc. 98001. East branch of Poplar River, on 49th parallel. Coll. G.M. Dawson, 1874.

42. GSC loc. 98002. Near base of Blood Reserve sandstone, Pothole Creek, SW 1/4, Sec. 34, Tp. 2, Rge. 22, W4th., Alberta. Coll. R.W. Landes.

43. GSC loc. 98003. About 3 miles west of Tilney, Ponteix, Saskatchewan. Coll. F.H. McLearn.

44. GSC loc. 98004. Headwaters of Moose River or Great Bend Creek, Tp. 2, Rge. 20, W2nd., Saskatchewan. Coll. O.J. Klotz, 1881.

45. GSC loc. 98005. Near Ponteix, 3 miles west of Tilney, Saskatchewan. Coll. P.S. Warren, 1930.

46. U.A. 03943 Near Ponteix, Saskatchewan. Coll. P.S. Warren.

47. U.A. 150. Sedalia, Alberta. Coll. Mr. Brekke.

48. U.A. 154. Lethbridge, Alberta.

49. U.A. 271. Well south of Youngstown. Coll. D. Bowman, 1931.

50. U.A. 349. Steveville, Alberta. Coll. W.E. Cutler.

51. U.A. 371. Steveville, Alberta. Coll. S. Davies.

52. U.A. 510. Southern Alberta.

53. U.A. 748. North side of Milk River, near Groton, Tp. 3, Rge. 10, W4th, Coll. J.A. Allen.

54. U.A. 7071. Near Cadillac, Saskatchewan. Coll. P.S. Warren, 1928.

55. U.A. 771. "Foxhill sst.", Sec. 33, Tp. 1, Rge. 22, W4th., Alberta. Coll. J.S. Irwin, 1930.

56. U.A. 1108. Upper beds of Pale Beds, Lost River, Tp. 1, Rge. 4, W4th., 2 miles north of 49th P., Silver Smoliak, Dr. Moore.

57. U.A. 1199. Notukeu Creek, east of Ponteix, Sec. 28, Tp. 9, Rge. 11, W3rd. Coll. P.S. Warren.

58. U.A. 7070 Alberta.

59. U.A. 03945 Berry Creek, Sec. 20, Tp. 29, Rge. 11, W4th. Coll. Al Goldin, 1946.

60. U.A. 03944 Drift, Southern Alberta.

Locality numbers 17, 18, 24, 33, 36, 39, 40, 52, 58, 60 have been excluded from the index map because the available information on them is too general.

FAUNAL ZONES AND CORRELATIONS

General Remarks

Warren (in Fraser et al., 1935, p. 21-22) recognized two faunal assemblages within the Bearpaw Formation, a lower one with **Placenticeras** and **Arctica** and an upper one with several scaphitid species of the **"nodosus group"** (see also Williams and Dyer, 1930). The stratigraphic occurrence of these scaphitids was later confirmed by Landes (in Russell and Landes, 1940, p. 185-186) who placed the bulk of the Bearpaw Formation into the **Baculites compressus** Zone.

A more detailed zonal scheme was proposed by Jeletzky (1968, 1970, 1971) who divided the **B. compressus** Zone into a "Zone K" characterized by **Arctica ovata** and by the extreme rarity of **"Hoploscaphites** ex gr. **nodosus** Owen"; a **"Hoploscaphites nodosus** and **Rhaeboceras** spp. Zone", and a **"Hoploscaphites quadrangularis** and **H. brevis** Zone". According to Jeletzky (1968, 1970, 1971) these zones are followed first by the Zone of **Hoploscaphites plenus, Baculites baculus** and **Inoceramus fibrosus**, and then by that of **B. grandis.**

In spite of an apparently haphazard distribution of baculitids in most sections, Caldwell (1968) recognized in the Bearpaw Formation many of the baculite zones previously established by Cobban (1951a, 1958a,b, 1962a,b), Scott and Cobban (1965) and Gill and Cobban (1966) for the Pierre Formation of the United States of America. North and Caldwell (1970) and Caldwell et al. (1978) also established a sequence of foraminifera assemblages and zones which were correlated with the baculite zonal scheme and Jeletzky's scaphitid zonation.

The use of scaphitids for the zonation of the Bearpaw Formation is made difficult by the complexity of their nomenclature. In several cases, it is not clear what is meant by the names of scaphitids listed from the Bearpaw Formation and used for its zonation. For example, Landes (in Russell and Landes, 1940, p. 176) did not include such species as **"Scaphites quadrangularis"** and **"S. brevis"** into his range chart of index fossils because of uncertainty as to what actually constitutes these species (cf. Brown, 1943). An attempt is being made here to clarify the nomenclature and the taxonomy of these and some other stratigraphically important scaphitids.

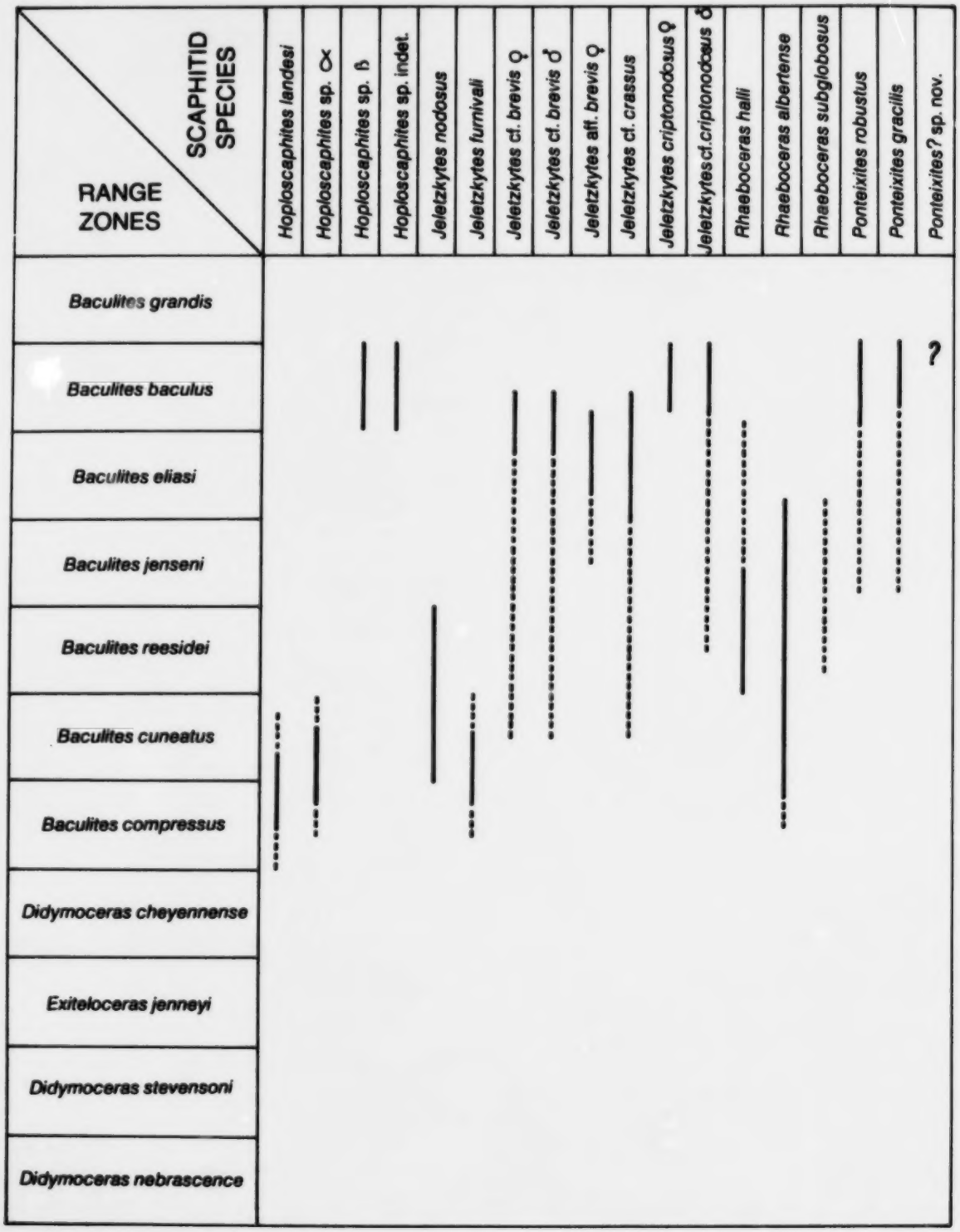
The index species of some of the United States Western Interior baculite zones have not yet been found in the Western Interior of Canada, whereas others appear to be poorly represented (see Jeletzky, 1968, p. 49; Forester et al., 1977; Caldwell et al., 1978). Nevertheless, an effort has been made here to interpret the stratigraphic occurrences of the described scaphitids in terms of the baculite zones (Table 1). This is important as it is apparent that most scaphitid species range through more than one baculite zone (see Caldwell, 1968, p. 68). In some cases such assignments have been facilitated by the presence of the zonal index baculites within the fossil assemblages concerned. In other cases, however, it has been necessary to rely on stratigraphic information recorded by collectors or published by other authors, which has resulted in much less reliable or even doubtful assignments. Nevertheless, even these records document the distribution of the scaphitids in the Bearpaw Formation, as they stand in the GSC collections available to the author.

Range Zones of Didymoceras nebrascense, D. stevensoni, Exiteloceras jenneyi, D. cheyennense, Baculites compressus

On the basis of a single fragment of **D.(?) stevensoni** (Whitfield), Caldwell (1968) suggested that the lower part of the Bearpaw Formation on the South Saskatchewan River could range as low as the Zone of **D. nebrascense** (Meek and Hayden), having therefore a range comparable to that of the formation in east-central Montana and a larger range than in southern Alberta.

For the same area Caldwell (1968) also recorded a single specimen of **Baculites rugosus** Cobban, indicative of the succeeding Zone of **Exiteloceras jenneyi.** He did not find, however, direct evidence for the **D. cheyennense** Zone. The succeeding **Baculites compressus** Zone is represented by the northern subspecies **B.c. robinsoni** Cobban (Plate 26, figs. 1-2).

Table 1. Time Ranges of Scaphitids of the Bearpaw Formation.



These zones apparently correspond to the lower part of the Bearpaw Formation, which Jeletzky (1968, 1971) segregated as the unnamed "Zone K" characterized by rare "**Scaphites** ex gr. **nodosus**".

In fact the collections studied by the author include very few scaphite specimens that could have been derived from this part of the sequence. The evidence suggests that they could come from its upper two zones. It is worth mentioning that the species **Hoploscaphites gilli** Cobban and Jeletzky (1965), which ranges from the **Baculites gregoryensis** to the **Didymoceras stevensoni** Zones, has not yet been recorded from the Bearpaw Formation of Canada, although it appears to be abundant in the underlying Lea Park Formation.

Hoploscaphites landesi sp. nov. could be present in the **D. cheyennense** and **B. compressus** Zones, for the type material is from the South Saskatchewan River, opposite the mouth of Swift Current Creek, where according to Caldwell's (1968, p. 25) stratigraphy, only the **E. jenneyi, D. cheyennense** and **B. compressus** Zones are present. From this same locality, however, comes a specimen of the index species of the **B. cuneatus** Zone (see Plate 25, figs. 1-3; Table 1). This specimen, described as "**B. grandis** Hall and Meek" by Whiteaves (1885, p. 50), was probably found by R.G. McConnell associated with the specimen here described under **J.** cf. **nodosus** (Owen) (see Plate 3, fig. 1).

The **D. nebrascense** to **B. compressus** Zones do not appear to be present in southern Alberta, and most of them are absent in the Cypress Hills area (see Forester et al., 1977, fig. 3).

Range Zones of Baculites cuneatus, B. reesidei and B. jenseni

The probable presence of **J.** cf. **nodosus** (Owen) in the **B. cuneatus** Zone has already been mentioned above.

From that same Zone, or from the lowermost part of the **B. reesidei** Zone, could also come **J. furnivali** sp. nov., a close relative of **J. nodosus** (Owen). The material on which this species is based comes from a level 183.0 m (600 ft) stratigraphically below the top of the Bearpaw Formation near McCoy Creek, Cypress Hills, an area where the formation is ca. 244.0 m (800 ft) thick (see Furnival, 1950, p. 46-50). **J. furnivali** is associated with **Rhaeboceras albertense**, a species usually found in association with **B. reesidei** Elias. In this connection it is worth mentioning that McCoy Creek is located immediately to the east of Boxelder Creek, where the holotype of **B. compressus robinsoni** was found 45.8 m (150 ft) above the base of the Bearpaw Formation (Robinson, 1945, p. 52).

The specimen of **J. nodosus** figured by Jeletzky (1970, Pl. 27, figs. 7a-b; here refigured in Plate 2, fig. 4-8) occurs in a stratigraphic position similar to that of **J. furnivali**. This specimen was found by R.W. Landes 91.5 m (300 ft) above the base of the Bearpaw Formation, near Manyberries, in "beds lower than any other of the scaphites from the same section" (Brown, 1943, p. 26). The material here included in **Hoploscaphites** sp. α is from the same area and level. Levels about 86.4 m (290 ft) above the base of the formation of the Manyberries section have been tentatively assigned to the upper part of the **B. compressus** Zone, close to the boundary with the overlying **B. cuneatus** Zone (Caldwell, 1968, p. 74).

The presence of ?**J. nodosus** in the **B. reesidei** Zone may be supported by material found by Macoun at the elbow of the Saskatchewan River, where this zone appears to be represented in the Snakebite Member (see Caldwell, 1968, text-fig. 8, p. 35, 71).

Conflicting evidence about the occurrence of **J.** cf. **brevis** ♀ & ♂ and **J.** cf. **crassus** in the **B. cuneatus** Zone is found in a solitary specimen of that baculite occurring in a collection (GSC loc. 10407, 10409) that is supposed to come from the Belanger Member. As the presence of these scaphites in the Belanger Member is supported by other collections, they could range through several zones, unless the **B. cuneatus** specimen has been misplaced in this collection.

The author does not have direct evidence for the presence of scaphitids in the **B. jenseni** Zone. However, the range of the genus **Rhaeboceras** Meek recorded by Gill and Cobban (1966, p. A35) makes it probable that the material included here in different species of **Rhaeboceras** is actually derived from that Zone.

It is worth mentioning that at least in one locality (GSC loc. 16326) **Ponteixites gracilis** appears to be associated with **B. reesidei.**

The Zones of **B. cuneatus, B. reesidei** and **E. jenseni**, which correspond to the **Anomalinoides** sp. Zone of the foraminiferal zonation (see Caldwell et al., 1978, p. 69), appear to be the most widespread in the Western Interior of Canada since **Rhaeboceras** spp. are not only present in southern Saskatchewan but are almost the only scaphitids found in most localities of Alberta. For example, representatives of this genus have been reported immediately below the Blood Reserve Sandstone in the Lethbridge section of the Bearpaw Formation (Russell and Landes, 1940, p. 175, 186). Furthermore, they seem to occur in the higher part of the Bearpaw Formation in the area of the Bow River, according to the stratigraphic data provided by Williams and Dyer (1930, p. 35) and the material available to the author. In contrast, Warren's (1930) type material of **R. albertense** seems to come from the basal part of the formation at the Steveville exposures (Landes, in Russell and Landes, 1940, p. 176). Finally, one specimen of **R. albertense** is apparently derived from the Uppermost Pale Beds of southeastern Alberta (Plate 18, figs. 1-2). If that finding were proven to be true it could imply that not only the top of the formation (see Russell and Landes, 1940, p. 81; Jeletzky, 1968, p. 48, 49), but also its base exhibits a marked change in age from east to west (see Caldwell, 1968; North and Caldwell, 1970). However, this suggestion seems to conflict with the evidence provided by Caldwell et al. (1978, p. 561) for the presence of the **B. compressus robinsoni** and **B. cuneatus** Zones in the Lethbridge area of southern Alberta.

According to the above data the Zones of **B. cuneatus, B. reesidei** and **B. jenseni**, which comprise most of the Manyberries Member of the Bearpaw Formation (see Forester et al., 1977) are approximately equivalent to the "**Hoploscaphites nodosus** and **Rhaeboceras** spp. Zone" of Jeletzky (1968, 1970, 1971).

Range Zones of Baculites eliasi and B. baculus

Determination of the **B. eliasi** Zone has been based on some rare specimens of the zonal index (e.g. Jeletzky, 1970, Pl. 27, figs. 4a-b) and the material identified as "**S. (H.) plenus**" (see Caldwell, 1968; Forester et al., 1977).

Scaphitids from the **B. baculus** Zone are certainly represented by **J. criptonodosus** ♀ and cf. ♂, and **Ponteixites robustus**, all of which occur together with the zonal index (see Plate 26, figs. 6-10; Table 1) in the Belanger Member. In the Cypress Hills, **Ponteixites robustus** Warren has been recorded at 28.0-28.3 m (92-93 ft) below the top of the Bearpaw Formation.

Most of the material included here in **J.** cf. **brevis** ♀ and ♂ is also supposed to come from the Belanger Member, and the apparent presence of **B. cuneatus** in the same assemblage (see above) probably is caused by a subsequent mixup of the collections. This material, however, differs from that included in **J. criptonodosus**, which comes from a

different locality of the Belanger Member. These faunal differences could have stratigraphic significance, since the material here referred to **J. aff. brevis** is probably associated with **Rhaeboceras halli** in the Dirt Hills of South Saskatchewan. The same collection (and level?) also contained the specimen of **B. eliasi** Cobban figured by Jeletzky (1970, Pl. 27, figs. 4a-b and herein Pl. 25, figs. 4-6). Furthermore, **J. cf. brevis** ♀ and ♂, occur together with **J. cf. crassus** (a close relative of **J. plenus**), a species that ranges through the **B. eliasi** and **B. baculus** Zones (see Caldwell, 1968, p. 69). Consequently, it seems possible that the material of **J. cf. brevis** is slightly older than that ascribed to **J. criptonodosus** ♀ and ♂.

From the Belanger Member of the same area comes a specimen here described under **Hoploscaphites** sp. indet., which seems to belong to the same species as the material from the Medicine Lodge Coulée section of southern Alberta, closely resembling **H. constrictus niedzwiedzkii** (Uhlig) (see Jeletzky, 1968, p. 51).

The Zones of **B. eliasi** and **B. baculus** are approximate equivalents of the "**Hoploscaphites brevis** and **H. quadrangularis**" and the "**Hoploscaphites plenus, B. baculus** and **Inoceramus fibrosus**" Zones/Subzones of Jeletzky (1968, 1970, 1971).

These two Zones appear to be mostly restricted to southern Saskatchewan, although they seem to be present also in Medicine Lodge Coulée, southern Alberta.

Range Zone of Baculites grandis

No scaphitids definitely assignable to this Zone are available to the author. A fragmentary multinodose specimen, presumably from the uppermost Bearpaw of southern Saskatchewan between Eastend and Ravenscrag (Sec. 30, Tp. 6, Rge. 22) identified as "**Scaphites (Discoscaphites)** ex gr. **roanensis** Stephenson" by Jeletzky (1970, p. 661, Pl. 27, figs. 10a-b) was ascribed to the **B. grandis** Zone (see Jeletzky, 1970, p. 651; 1971, p. 9). However, the specific status and stratigraphic position of that specimen remains questionable (see Jeletzky and Waage, 1978, p. 1120).

CAMPANIAN-MAASTRICHTIAN BOUNDARY

The Bearpaw Formation probably ranges from as low as the Zone of **Didymoceras stevensoni** to as high as the Zone of **Baculites grandis.**

Accepting Jeletzky's (in Cobban and Reeside, 1952, and 1968) positioning of the Campanian-Maastrichtian boundary at the base of the **Baculites baculus** Zone, most of the Bearpaw Formation could be Late Campanian, although the uppermost levels of southern Saskatchewan could be Early Maastrichtian.

Cobban's (see Obradovich and Cobban, 1975; North and Caldwell, 1975a, p. 329) placing of the boundary at the base of the **Baculites reesidei** Zone would imply that the Bearpaw Formation is about equally divided between the latest Campanian and the earliest Maastrichtian. When K-Ar age data on bentonites (see Obradovich and Cobban, 1975, Table 1) are compared with van Hinte's (1976) Cretaceous time scale the boundary should be located between the **Baculites compressus** and the **B. cuneatus** Zones and most of the Bearpaw Formation would be lower Maastrichtian.

All these data indicate that the scaphitids here described probably range in age from the late Campanian to the early Maastrichtian. The apparent relationships and similarities of these specimens with the Eurasian scaphitids also substantiate this age range. A more detailed discussion of the Campanian-Maastrichtian boundary in North America must include all other stratigraphic information available to date, and is beyond the scope of this paper.

PALEONTOLOGICAL DESCRIPTIONS

Class CEPHALOPODA Leach, 1817
Subclass ECTOCOCHLIA Schwartz, 1894
Order AMMONOIDEA Zittel, 1884
Family SCAPHITIDAE Meek, 1876
Subfamily SCAPHITINAE Meek, 1876

Comments

Species belonging to the genera and subgenera **Hoploscaphites** Nowak, 1911, **Jeletzkytes** gen. nov. (including the "**nodosus** group" of previous authors), **Rhaeboceras** Meek and **Ponteixites** Warren occur in the Bearpaw Formation of Canada.

Several theories on the phylogeny of the scaphitids have been reviewed by Nowak (1911), Diener (1916), Reeside (1927a), and more recently by Schindewolf (1960), Wiedmann (1965) and Birkelund (1965). Most of their conclusions do not need to be reviewed here. Birkelund's (1965, 1966) observations are, however, relevant in considering the relationships of the scaphitids from the Bearpaw Formation. This statement is especially true with regard to one of the two important groups, i.e. the "**nodosus** group", found in that formation.

The present study supports Birkelund's conclusions about the evolutionary tendency within that group leading from species with small apertural angle and tubercles restricted to the last part of the phragmocone and body chamber to species with larger apertural angle and presence of tubercles in the inner whorls of the phragmocone.

These features of the "nodosus group" (which will be discussed in detail below) seem to differ from those found in species such as **Hoploscaphites greenlandicus** (Donovan), **H. gilli** Cobban and Jeletzky and **H. nicolletii** (Morton) which are more clearly related to **H. constrictus**, the type species of **Hoploscaphites** Nowak.

As will be mentioned later, the **Hoploscaphites** lineage is characterized by the absence of nodes on the phragmocone, a decreased number of ribs, the development of umbilical bullae-like tubercles, and larger, more plentiful and densely spaced ventrolateral tubercles on the body chamber (see Waage, 1968, fig. 11; Birkelund, 1966, 1979, p. 55; Blaszkiewicz, 1980, Pl. 17 and 18).

The **Hoploscaphites** lineage existed in the Upper Campanian of the Western Interior of North America, Greenland and northern Europe (see Waage, 1968, p. 146). Several specimens from the Bearpaw Formation of Canada suggest its presence there alongside the "**nodosus** group". A similar situation seems to exist in Europe (see Blaszkiewicz, 1980) where **Hoploscaphites** representatives occur in the upper Campanian-Maastrichtian together with species included in **Acanthoscaphites**, though resembling the "**nodosus** group". Therefore, it is possible that the "**nodosus** group" was also represented in Europe. However, during Maastrichtian times it gave place to a different lineage, i.e. the true **Acanthoscaphites**, than those found in North America. This suggests that the "**nodosus** group" was a separate lineage endemic to the Western Interior of North America. The possibility that **Hoploscaphites** and the "**nodosus** group" have been derived from the same ancestors (see Birkelund, 1965, p. 72) has yet to be explored, although the existence of specimens with transitional morphology supports that view.

It appears that in Maastrichtian time the "**nodosus** group" was replaced by a series of morphologically distinctive endemic multituberculate scaphitids resembling **Discoscaphites** Meek (see Jeletzky and Waage, 1978, p. 1121) whereas changes within the pandemic **Hoploscaphites** lineage appear to have been relatively more subtle.

Besides the "**nodosus**-group", the numerically more important group of scaphitids in the Bearpaw Formation is represented by **Rhaeboceras** Meek. Species of this group [e.g. **R. albertense** (Warren)] seem to have appeared at about the same time as the first true representatives of the "**nodosus** group", though it was survived by the latter. It seems possible, therefore, that **Rhaeboceras** constitutes a short-lived offshoot of the main "**nodosus** stock". The available evidence, however, does not permit a definite conclusion.

Ponteixites Warren appears to represent dwarfed derivatives of **Rhaeboceras**, and both genera seem to be endemic to the Western Interior of North America. Nevertheless, similarities between the phragmocones and suture lines of **Rhaeboceras** and **Acanthoscaphites** Nowak, from the Maastrichtian of Europe and the probable presence of a solitary representative of **Rhaeboceras** in the Donetz Basin (Naidin, 1974), suggest that **Acanthoscaphites** may have originated in some migrant representative of **Rhaeboceras**.

Genus **Hoploscaphites** Nowak, 1911

Type species. **Scaphites constrictus** J. Sowerby, 1818.

Diagnosis. Scaphitids with very involute phragmocone, body chamber usually has a short shaft and a slightly recurved hook; aperture with a dorsal lappet and occasionally with a weak ventral projection; younger part of phragmocone always compressed with flattened sides and rounded venter; ribs flexuous with a weak lateral projection and occasionally with a very weak ventral projection; surface with or without umbilical and ventrolateral nodes on body chamber; suture with a symmetric to slightly asymmetric bifid lateral lobe (Birkelund, 1965, p. 102).

Comments. Nowak (1911) proposed the generic name **Hoploscaphites** for the group of **Scaphites constrictus** Sowerby. In defining the new genus, however, Nowak (1911, p. 565-566) included a list of seven species of which the first was "**H. rochatianus** d'Orbigny" and the last "**H. constrictus** Sowerby". However, on page 580 he only described **H. constrictus** Sowerby. Therefore, Reeside (1927a) and all subsequent authors (see Cobban and Jeletzky, 1965; Birkelund, 1965) have taken this last species as the type of the genus.

In Nowak's (1911) original diagnosis, **Hoploscaphites** included species with compressed and involute whorls, the ornament consisting of arched ribs, which at the middle of the flank and on the venter are bent forward, and which fork at different heights on the flanks without forming nodes.

Besides the features listed, Reeside (1927a, p. 26) pointed to the commonly moderate size of the shells and the presence of few to many nodes on the flanks. This was done as Reeside (1927a) followed Nowak (1911) and Diener (1916, p. 925) in regarding all **Discoscaphites** species as closely related to **Hoploscaphites**. Nowak's (1911) treatment of **Discoscaphites** as a synonym of the latter being incorrect, Reeside considered **Hoploscaphites** to be a junior subjective synonym of **Discoscaphites**. Reeside (1927a) also followed Nowak (1916) in placing the North American "**nodosus** group" in the European **Acanthoscaphites** Nowak.

Since then the relationships between the species grouped within these three genera have been clarified by Cobban and Jeletzky (1965), Birkelund (1965) and Jeletzky and Waage (1978). Thus, **Hoploscaphites** has been validated with about the same diagnostic features that were given to it by Reeside (1927a, p. 26), whereas **Discoscaphites** has been restricted to small to medium-sized multinodose scaphitids with two or more lateral rows of nodes in addition to the ventrolateral and umbilical nodes. **Acanthoscaphites** Nowak was restricted to the group of **A. tridens** Kner, which is characterized by a median row of tubercles on the ventral side of the body chamber.

For a long time **H. constrictus** was considered to have a wide range of variability. Consequently, some names of subspecific rank were erected. Nowak (1911) introduced the "var. **vulgaris**" for the typical form and at the same time treated **H. tenuistriatus** Kner as a finely ribbed variety of **H. constrictus**. Uhlig (1895) even introduced "**Scaphites niedzwiedzkii**" for its small and widely umbilicate variants. More recently Birkelund (1979, p. 55) has accepted the subspecies **H. constrictus crassus** (Łopuski, 1911, Pl. II, figs. 5-6, Pl. III, figs. 1-2) on the basis of its more inflated shape and the development of strong nodes all the way from the phragmocone to the aperture. However, the distribution of nodes in this species seems to be quite variable, as illustrated by Nowak (1911, Pl. 33, fig. 8-12) and Blaszkiewicz (1980, Pl. 18).

Actualy **H. constrictus** includes two main morphological groups, with some extreme variants within them, that could be interpreted as members of a sexually dimorphic species (Makowski, 1962, p. 31, Text-plate IV; Cobban, 1969, p. 8).

The probable macroconch is usually smaller than 55 mm (see Sowerby, 1818, Pl. A, fig. 1; d'Orbigny, 1840-42, Pl. 129, fig. 11; Alth, 1850, Pl. X, fig. 27; Hauer, 1858, Pl. I, fig. 8; Binkhorst, 1861, Pl. Vd, fig. 6b,c; Favre, 1869, Pl. V, figs. 2,3; Schlüter, 1872, Pl. 28, fig. 7; Böhm, 1891, Pl. I, fig. 10a; Grossouvre, 1893, Pl. 31, figs. 7-8; 1908, Pl. XI, fig. 3; Łopuski, 1911, Pl. 2, figs. 3-4; Mikhailov, 1951, Pl. XVII, fig. 79; Blaszkiewicz, 1980, Pl. 18, fig. 1-3, 11-14). It is characterized by a compressed and involute phragmocone and body chamber, umbilical swelling at the base of this last, almost smooth flanks where the ornament is mostly restricted to weak iregular ribs and ventrolateral nodes; the ribs are, however, more conspicuous on the phragmocone where the nodes are wanting.

The probable microconch of **H. constrictus** (see d'Orbigny, 1840-42, Pl. 129, fig. 10; Binkhorst, 1861, Pl. Vd, fig. 6a,d; Favre, 1869, Pl. V, fig. 1,4; Schlüter, 1872, Pl. 28, fig. 5; Böhm, 1891, Pl. I, fig. 10; Grossouvre, 1893, Pl. 31, fig. 2; 1908, Pl. XI, fig. 4-7; Łopuski, 1911, Pl. III, fig. 5; Wolansky, 1932, Pl. I, fig. 12; Naidin and Shimansky, 1959, Pl. 6, figs. 7-8) is usually smaller than the macroconch, with a more evolute body chamber, without umbilical swelling and with more robust ribbing on the body chamber, which can include a row of umbilical tubercles. Probable microconchs of **H. constrictus** have also been included in "**Scaphites niedzwiedzkii**" Uhlig (1895, p. 220, fig. 2; ? Böhm and Heim, 1909, Pl. I, figs. 3a-b; Mikhailov, 1951, Pl. 17, figs. 81-82; Pl. 18, fig. 85; Naidin and Shimansky, 1959, Pl. VI, fig. 1-4; Naidin, 1974, Pl. 58, figs. 10-11). The possibility that "**Scaphites**" **pungens** Binkhorst (1861, Pl. Va3, figs. 1a-d) represents an extreme (microconch) variant of **H. constrictus** has also been suggested (see Grossouvre, 1908, p. 37).

Closely related to **H. constrictus** Sowerby, within which it has been often included as a subspecies, is **H. tenuistriatus** Kner (1850, Pl. I, fig. 5). This species, as originally figured (see also Favre, 1869, Pl. V, figs. 6-7) is characterized by its compression, fine ribbing, short shaft and absence of nodes. Schlüter (1872, p. 89) included all such specimens in "**Scaphites roemeri** d'Orbigny". However, as stated by Birkelund (1965, p. 102), this last name was introduced by d'Orbigny (1850) for the specimen figured by Roemer (1841, Pl. XV, fig. 1) under the preoccupied name **Scaphites compressus**. Furthermore, one year before, Giebel (1849) designated Roemer's specimen as **Scaphites tuberculatus** Giebel (cf. Sornay, 1955).

Despite Schlüter's (1872) awareness of this fact, he maintained the name "**Scaphites roemeri**", and referred specimens to it with two rows of nodes as well as those with one or none. It seems evident, however, that Schlüter's (1872, Pl. 27, fig. 1-4) material differs from that

figured by Kner (1850) and Favre (1869) under **"Scaphites tenuistriatus"**, in the larger shaft, less dense ribbing and presence of ventrolateral nodes. Therefore, **Scaphites tenuistriatus** was regarded as a finely ribbed variety of **H. constrictus** (see Nowak, 1911, p. 582; Wolansky, 1932; Mikhailov, 1951; Naidin and Shimansky, 1959; Naidin, 1974), or as an independent species (see Birkelund, 1966, 1979). Meanwhile, through the work of Birkelund (1965) it became clear that the European material included by Schluter (1872) in **"Scaphites roemeri"** was closely related to scaphitids described from the Upper Campanian of Greenland as **Hoploscaphites greenlandicus** (Donovan), **H. ikorfatensis** and **H. ravni** Birkelund spp. (see Moberg, 1885, Pl. 3, fig. 9; Madsen, 1897, Pl. 1, figs. 1-3; Ravn, 1918, Pl. 8, fig. 18; Pl. 9, fig. 2; Rosenkrantz, 1942, p. 40; Donovan, 1953, Pl. 24, figs. 9-10; 1954, Pl. 2, figs. 4-5; Ødum, 1953, Pl. 2, fig. 2; Birkelund, 1965, Pl. 24, figs. 1-4; Pl. 25, figs. 1-2; Pl. 26, figs. 1-4; Pl. 27, figs. 1-4; Pl. 28, figs. 1-3; Pl. 29, figs. 1-2; Pl. 30, fig. 1-3; Pl. 31, figs. 1-2; Pl. 32, fig. 1; Pl. 33, fig. 1), and that they could be considered conspecific. The name **H. greenlandicus** Donovan has therefore been adopted (see Schmid and Ernst, 1975; Wiedemann, 1979, p. 344); Blaszkiewicz, 1980, p. 33).

The similarities between **H. greenlandicus** and related material from Europe and Greenland with **H. gilli** Cobban and Jeletzky (1965) from the Western Interior of North America have already been pointed out by Cobban and Jeletzky (1965) and Birkelund (1965).

Scaphites tuberculatus Giebel, as can be seen in the material figured by Roemer (1841, Pl. 15, fig. 1), Frech (1915, fig. 14), and Schmid and Ernst (1975, Pl. 3, fig. 1), and Blaszkiewicz (1980, Pl. 16, fig. 1-3, 5; Pl. 19, fig. 1,4; Pl. 20, fig. 4-5), as well as in several plaster casts and specimens (see Pl. 4, figs. 5,6) kindly provided by F. Schmid, seems to differ from **H. tenuistriatus** and **H. greenlandicus** in the presence of a row of lateral nodes besides the ventrolaterals. This lateral row of nodes seems to be generally absent in the macroconchs of **H. constrictus, H. tenuistriatus,** and **H. greenlandicus.** Usually, only some small specimens (?microconchs) of these species (see d'Orbigny, 1840-42, Pl. 129, fig. 10; Binkhorst, 1861, Pl. Vd, fig. 6a; Favre, 1869, Pl. V, fig. 1; Redtenbacher, 1873, Pl. 30, fig. 12; Naidin and Shimansky, 1959, Pl. VI, figs. 1-4, 7; Birkelund, 1965, Pl. 24, fig. 3; Pl. 25, fig. 2; Pl. 27, fig. 4; Naidin, 1974, Pl. 58, figs. 7-8, 10; Blaszkiewicz, 1980, Pl. 18, fig. 4-10) exhibit bullae-like tubercles on the lower part of the flanks. This is a feature usually coupled with strong ornament throughout the body chamber. However, this appears to be a common morphology in most microconchs, as exemplified by those here included under **Jeletzkytes** gen. nov. (see below).

Nevertheless, among the different European specimens described within **H. constrictus** there are some probable macroconchs (see Kner, 1852, Pl. XV, fig. 13; Grossouvre, 1893, Pl. 31, fig. 1; Mikhailov, 1951, Pl. XVII, fig. 77; Blaszkiewicz, 1980, Pl. 18, fig. 10) with umbilical nodes. They are, usually larger than most macroconchs of **H. constrictus.**

Atabekyan (1979, p. 523) has, therefore, considered that some of these specimens (Grossouvre, 1893, Pl. 31, fig. 1, and Kner, 1852, Pl. XV, fig. 13) belong in new species related to **"Scaphites (Hoploscaphites) elatensis"** Lewy (1969). On that basis Atabekyan (1979) introduced one generic and two specific new names, i.e. **Mesoscaphites grossouvrei** Atabekyan (Grossouvre, 1893, Pl. 31, fig. 1; Kner, 1850, Pl. 1, fig. 4; Favre, 1869, Pl. V, fig. 4) and **M. kneri** Atabekyan (Kner, 1852, Pl. XV, fig. 13). The generic name, however, lacks diagnosis or any statement relating to it, being therefore invalid under the ICZN rules.

Furthermore, the specimen on which the proposed type species is based, i.e. **"Scaphites (Hoploscaphites) elatensis"** Lewy, appears to be a microconch (Lewy, 1969, Pl. IV, fig. 2a-c). Its true affinities are, therefore, difficult to assess.

Nevertheless, all these specimens, of a late Campanian to Early Maastrichtian age, could in fact represent a new genus. Furthermore, **Scaphites tuberculatus** Giebel (? incl. **S. elegans** Tate; see Blaszkiewicz, 1980, p. 38) could be another of its representatives.

Thus, **Hoploscaphites** includes a group of closely related species which are represented in the Upper Campanian-Maastrichtian of different parts of the world, although it appears to be more abundant in the Northern Hemisphere. In the Upper Campanian it is represented by **H. gilli** in North America and by **H. greenlandicus** in Greenland and Europe. These species are succeeded in Maastrichtian times by **H. constrictus** and **H. tenuistriatus** in Europe and by **H. nicolletii** (Morton) in North America (see also Birkelund, 1966, fig. 1).

This genus seems to be poorly represented in the Bearpaw Formation of Canada, although the few specimens collected suggest that it is present throughout it.

Some of these earliest representatives, here included in **H. landesi** sp. nov., have bullae or thickened ribs on the lower part of the flanks and could, therefore, be transitional to the "nodosus group".

Hoploscaphites landesi sp. nov.

Plate 1, figs. 12-22

Holotype. The almost complete specimen figured on Plate 1, figs. 12-14, is from the Bearpaw Formation, ?Demaine Sandstone, South Saskatchewan River, opposite the mouth of Swift Current River, Saskatchewan (coll. T.C. Weston, 1889; GSC 5342a) (GSC loc. 97988).

Derivation of name. The species is named for Dr. R.W. Landes who made collections of fossil invertebrates and studied the stratigraphy of the Bearpaw Formation in the southern Alberta plains.

Diagnosis. Relatively small shell, body chamber extends slightly beyond the phragmocone, which results in only a slight gap between it and the mouth border; whorl section compressed, subrectangular throughout; apertural angle 120-125°; ribbing flexuous, becoming denser and finer from the phragmocone to the body chamber. Body chamber with small bullae on the lower third of the flanks, forming bundle-like swellings with the ribs. Small ventrolateral tubercles restricted to the straight middle third of the body chamber.

Material. The holotype (GSC 5342a); 2 complete but crushed specimens (GSC 5342/b-c) and 2 fragments (GSC 5342/d-e) from the ?Demaine Sandstone, Bearpaw Formation, and South Saskatchewan River opposite mouth of Swift Current River, Saskatchewan (coll. T.C. Weston, 1889; GSC loc. 97988).

Description. The length of the mature shell ranges between about 38 and 48 mm.

At its maximum diameter, i.e. c. 22-31 mm, the phragmocone is involute (U/D = 0.10), with compressed whorl section (w/h = 0.50-0.60). The flanks are almost parallel and pass into a low arched venter.

The ornament consists of sharp and dense prosocline ribs. Primaries, numbering c. 6-8 in the last half whorl of the phragmocone, bend back slightly at the umbilical margin, and then curve forward across the lower third of the flank. Approximately below the middle of the flanks and higher c. 3 to 5 secondaries born from or appear between the

primaries. They curve gently backwards, and forwards again as they approach the ventrolateral shoulder. All ribs cross the venter with a weak adoral projection. Primaries are usually slightly more prominent than the secondaries.

The body chamber egresses markedly, extending slightly beyond the phragmocone. The umbilical margin forms a weakly concave arch and the umbilical wall varies from subvertical to vertical. The whorl section varies from rectangular to subrectangular, with flat and almost parallel flanks, but becoming progressively less compressed towards the aperture (W/H = 0.75) by negative allometry of width. Along the shaft the flanks merge with the narrow and flat venter forming a distinctive ventrolateral shoulder, a feature enhanced by the presence of tubercles. In the last quarter of whorl, however, the venter is wider and broadly rounded and passes evenly into the flanks. The apertural angle is c. 120-125° and the aperture is slightly constricted.

The pattern of sculpture on the body chamber is similar to that described for the last whorl of the phragmocone. But most primary ribs become slightly thickened, forming weak bullae on the lower third of the flanks. Numerous secondaries emanate from these bullae and at different heights of the flanks. They are fine, becoming denser towards the aperture, and number about 90-110 on the venter of the body chamber. All ribs cross the venter with a gentle forward projection and without weakening or interruption. About 5-6 ventrolateral nodes are developed along the middle part of the body chamber. They are usually small, although those in the middle are slightly larger.

The suture line is unknown.

Comments. This species resembles **Hoploscaphites gilli** Cobban and Jeletzky (1965, see Pl. 95, fig. 1A), a species known from the **Baculites perplexus** to the **Didymoceras stevensoni** range-zones of the Western Interior of North America. It differs, however, in the more compressed whorl section, the almost tabulate venter of the living chamber, the conspicuous lateral bullae and the apparently constant presence of ventrolateral nodes on the body chamber.

This species is also similar to some material from West Greenland described by Birkelund (1965, Pl. 24, figs. 3-4; Pl. 25, fig. 2) as **Scaphites (Hoploscaphites) ikorfatensis** Birkelund. The Canadian species has, however, a greater compression, more flexuous ribs on the phragmocone, and larger apertural angle. **H. landesi** is rather similar to **H. minimus** Blaszkiewicz (1980, p. 35, Pl. 23, fig. 4; Pl. 24, fig. 3; Pl. 25, fig. 3-4) in size, compression, apertural angle and style of ornament. It differs, however, in the relatively less compressed phragmocone and body chamber, presence of umbilical bullae and larger ventrolateral nodes. **H. landesi** sp. nov. differs from **H.** nov. sp.α described below, in the smaller size, larger compression, denser and finer ribbing and presence of umbilical bullae.

Dimensions (in mm):

	L	D	U	h	w
1. GSC 5342/a	48.7	31	3.4(0.10)	17.7(0.57)	8.8(0.28)
2. GSC 5342/b	38.8	22	2.3(0.10)	11.6(0.52)	6.9(0.31)
3. GSC 5342/c	38.6	23.8	2.4(0.10)	13.6(0.57)	+7.0(0.29)

	l	l/L	H	W	w/h	W/H	A	P	S	Ex
1. GSC 5342/a	11.3	0.23	18.4	14	0.49	0.73	120°	11	140	6
2. GSC 5342/b	10.8	0.27	15.5	11.4	0.59	0.73	118°	17	103	6
3. GSC 5342/c	8.9	0.23	-15.6	+9.3	+0.51	+0.59	125°	18	120	5

Hoploscaphites sp. α

Plate 1, figures 1-11; Text-figures 3-4

Material. One incomplete phragmocone with part of the body chamber (GSC 67087), one phragmocone with incomplete body chamber (GSC 67088) and one incomplete phragmocone (GSC 67089), from 91.5 m (300 ft) above the base of Bearpaw Formation in Manyberries section, Sec. 30, Tp. 5, Rge. 4, W4th, Alberta (Coll. R.W. Landes, GSC loc. 16395); ?one complete shell but with crushed end of body chamber, from Notukeu creek, near Cadillac, Saskatchewan (Coll. P.S. Warren, 1928; no. 765); ?one incomplete fragment of whorl including the end of the phragmocone and the beginning of the body chamber, GSC loc. 97989, from west of Milestone, Sec. 28, Tp. 11, Rge. 21, W2nd, Saskatchewan.

Description. The length of the mature shell seems to range between 65 and 75 mm.

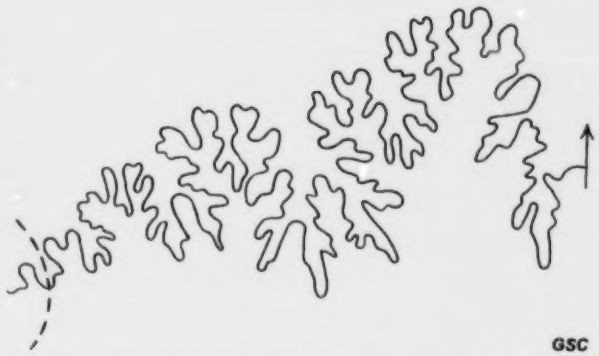
The phragmocone is involute (U/D = 0.11-0.17), between 15 and 35 mm of diameter, and the umbilical ratio seems to decrease with age. The umbilical wall is vertical. The whorl section is subrectangular, compressed, higher than wide (w/h = 0.69-0.75), with almost parallel flanks and weakly convex venter. The ornament consists of sharp flexuous ribs and a few ventrolateral tubercles. Primary ribs appear, in number of c. 11-15 per whorl, on the upper part of the umbilical wall. At first they are rursiradiate, but on the lower part of the flank are projected toward the aperture. They bend backwards and forwards again in the middle of the flank forming shallow adapically concave arches, and cross the venter with a slight apertural projection. Between three and five secondaries become intercalated at different heights of the flanks. At first they are weaker than the primaries, but on the upper part of the flank all ribs, c. 60 per whorl, have similar strength.

At about 30-35 mm of diameter small ventrolateral tubercles appear. Thereafter they are developed on every 5th-6th rib.

The adult phragmocone ends between c. 27-46 mm of diameter. In large specimens the body chamber egresses markedly, although it only seems to extend slightly beyond the phragmocone whereas in small specimens it has little egression and appears to remain in contact with the phragmocone. Height and width increase from the last suture onwards, and the younger part of the body chamber seems to be less compressed than the older part. The whorl section remains subquadrate in shape, with almost parallel flanks, weakly rounded venter and vertical umbilical wall. In large specimens the inner margin of the shaft is almost straight, although it develops a swelling of variable size.

Ribbing becomes more densely spaced towards the aperture, but remains sharp and flexuous. One or two of the primaries located at the beginning of the body chamber develop a slight bullae-like thickening, but this feature does not seem to persist in the younger part of the body chamber. There are about 30 primaries and 90-110 secondaries in the last exposed whorl. The ventrolateral tubercles become larger until the middle part of the body chamber, where they become smaller again.

The suture (text-figs. 3-4) is incised with the lateral lobe as deep as the ventral lobe. The lateral lobe is trifid and asymmetric. The first auxiliary lobe is about half as deep as the lateral lobe and asymmetrically bifid. Two to three auxiliary lobes are visible until the umbilical border. The saddles are incised. The first lateral saddle is divided into two main branches, the ventral branch being larger than the dorsal. The second lateral saddle is narrow and divided into three subequal branches.



GSC

Text-figure 3. ***Hoploscaphites*** *sp. a, Suture line of specimen UA 7070, at H = 19.2 mm and W = 15. (See Plate 1, figs. 1-2).*

Comments. The available material consists of few and incompletely preserved specimens. Therefore, the taxonomic significance of some observed morphological differences cannot be properly assessed. Thus, one specimen (GSC 67088) is smaller and has a more evolute mature phragmocone and less detached body chamber than the larger specimen (GSC 67087) coming from the same locality. As both specimens appear to agree in all other features they are here included in the same species. The mentioned differences could correspond to those usually found within a single dimorphic pair.

The specimen from southern Saskatchewan (UA 7070) (figured on Pl. 1, figs. 1-2), is tentatively included in this species because of the similarities it exhibits. However, it is more evolute, has a larger swelling in the inner margin of the shaft, and seems to have slightly denser and less flexuous ribbing on the body chamber. The suture line (cf. text-figs. 3-4) is also more incised. The fragment from west of Milestone is similar to all other specimens in compression and ribbing. However, it seems to have better defined (?) and persistent node-like bullae at the boundary between the phragmocone and the body chamber.

All these specimens do not fit in any described species, although they resemble some species of **Hoploscaphites**. Of those described from the Western Interior, **H. gilli** Cobban and Jeletzky exhibits some superficial similarity in the flexuous ribs and absence of lateral tubercles. That species, however, is smaller in size, has finer and denser ribbing and simpler suture line. **Hoploscaphites nicolletii** (Morton, 1842, Pl. 10, fig. 3; Meek, 1876, Pl. 34, fig. 24; Reeside, 1927a, Pl. 9, figs. 5-7; Waage, 1968, fig. 11; Kauffman, 1977, Pl. 32, fig. 10) differs quite clearly in the smaller size, larger compression, different pattern of the finer, denser and ventrally projected ribbing, and (when present) larger number and closer spacing of ventrolateral tubercles.

In fact, this species resembles **Jeletzkytes brevis** (Meek, 1876, Pl. 25, figs. 1a-c), but its body chamber is more compressed. Furthermore, it has a sparser ribbing, lacks the lateral bullae-like tubercles, and has a simpler suture line than this latter species.

It must also be pointed out that this species exhibits some similarities with **Scaphites rosenkrantzi** Birkelund (1965, Pl. 21, figs. 3a-c; Pl. 22, figs. 2a-b; Pl. 23, figs. 2a-b) from West Greenland, although it seems to differ in an even sparser and more flexuous ribbing, especially on the phragmocone, the more compressed whorl section, and more complex suture line. An almost similar compression, and absence of lateral nodes, is also found in **Hoploscaphites**

GSC

Text-figure 4. ***Hoploscaphites*** *sp. a. a) suture line of specimen GSC no. 67088, at H = 10.5 mm and W = 7.9 mm (see Plate 1, fig. 6-9); b) suture line of specimen GSC no. 67087, at H = 8.4 mm and W = c. 6.5 mm (see Plate 1, fig. 3-5).*

ikorfatensis Birkelund (1965, Pl. 24, figs. 1-2). However, as in the related species **H. ravni** Birkelund and **H. greenlandicus** (Donovan) (see Birkelund, 1965; Blaszkiewicz, 1980), its ribbing is finer and denser than that of the Canadian species.

Dimensions (in mm):

	L	D	U	h	w
1. GSC 67087 phragmocone	65-70	39.5	6.0(0.11)	19.8(0.57)	14.0(0.40)
2. GSC 67088 phragmocone	-	27	4.6(0.17)	10.4(0.57)	10.9(0.40)
3. GSC 67089 phragmocone	-	30	3.4(0.11)	17.3(0.57)	12.0(0.40)
4. U.A. 7070	73	46	3.4(0.07)	26.2(0.56)	19.9(0.43)

	I	I/L	H	W	w/h	W/H	A	P	S	In	Ex
1. GSC 67087	c.17	0.25	-	-	0.70	-	-	26	-	-	-
2. GSC 67088	-	-	-	-	0.73	-	-	11	-	-	2
3. GSC 67089	-	-	-	-	0.69	-	-	13	60	-	-
4. U.A. 7070	19.3	0.26	-	-	0.73	-	-	36	116	-	14

Hoploscaphites sp. β

Plate 1, figures 27-29

Material. One phragmocone with part of the body chamber (GSC 67090) and two or three fragments, from SW of Milestone, SE 1/4, Tp. 10, Rge. 20 W2nd, Saskatchewan (Coll. R. Graham, 1936, GSC loc. 10437).

Description. Up to about 14 mm of diameter the phragmocone is relatively evolute (U/D = 0.24), with subvertical umbilical wall, subrounded whorl section (W/H = 0.98), with curved flanks and venter. The ornament consists of sparse, prominent, rounded and slightly prorsiradiate ribs, which on the ventrolateral shoulder bear relatively prominent tubercles. Two secondaries originate from each tubercle on the venter, and two more become intercalated on the umbilical shoulder. All secondaries cross the venter forming a shallow adapertural arch.

Between 15 and 22 mm of diameter the (?adult) body chamber is relatively more involute (U/D = 0.19), with steep umbilical walls. The whorl section becomes compressed (W/H = 0.76), subrectangular in shape, by positive allometry of height. The flanks are parallel and the venter is almost tabulate.

On the last whorl are 14-15 primaries, which become progressively finer and denser. They are prorsiradiate and slightly flexuous. Some are weaker and barely visible on the lower part of the flank, but all of them attain similar strength near the ventrolateral shoulder, where some secondaries are also intercalated. Between c. 14 and 20 mm of diameter there are no ventrolateral tubercles and all ribs cross the venter with a slightly forward projection. At larger diameters, however, small and sharp tubercles are again developed on the ventrolateral margin, at least in one of every two ribs. On the venter these ribs split into two secondaries. There are about 53 secondaries on the last whorl.

The suture line, only visible at small diameters, is relatively simple, with a first lateral lobe trifid and almost as deep as the ventral lobe. The first lateral saddle is wide and all secondary elements rise towards the umbilical seam.

Comments. The most conspicuous feature of this species is the change from rounded and strongly ornamented inner whorls, to compressed and finely ribbed outer whorls. Other characteristic features are the slow egression of the body chamber and the development with growth of numerous, small, sharp and closely spaced ventrolateral tubercles.

In all the features present in the last available growth stages this material resembles **Hoploscaphites mandanensis** (Morton) and **H. nicolletii** (Morton).

H. mandanensis (Morton, 1842, Pl. X, fig. 2; Meek, 1876, Pl. 35, fig. 1; Kauffman, 1977, Pl. 32, fig. 5), however, is more compressed, even in the inner whorls, relatively more evolute, and has relatively thicker lateral ribs with incipient umbilical tubercles. It also has more numerous and closely spaced ventrolateral tubercles. But the suture line is also relatively simple and ascendant towards the umbilical seam.

H. nicolletii (Morton, 1842, Pl. X, fig. 3; Meek, 1876, Pl. 34, fig. 2,4; Reeside, 1927a, Pl. 9, figs. 5-7; Jeletzky, 1962b, Pl. 141, figs. 1a-d; Waage, 1968, fig. 11; Kauffman, 1977, Pl. 32, fig. 10) is usually more involute, and compressed. Furthermore it has denser, finer and more flexuous ribbing with branching of ribs near the umbilical margin. The ventrolateral tubercles seem also to be restricted to later growth stages, and the suture line is slightly more complex, although it also has raised umbilical elements.

Dimensions (in mm):

GSC 67090	D	U	H	W	P	S	W/H
Body ch.	22.4	4.3(0.19)	11.8(0.53)	9.0(0.40)	15	53	0.76
Phrag.	14	3.4(0.24)	6.0(0.43)	5.9(0.42)	-	-	0.98

Hoploscaphites sp. indet.

Plate 1, figures 23-26

1940. **Discoscaphites abyssinus** (Morton), Landes, p. 179.
1952. **Scaphites (Hoploscaphites) constrictus** Sowerby, Jeletzky, in Cobban and Reeside, p. 1027.
1968. **Scaphites (Hoploscaphites) constrictus** s.l., Jeletzky, p. 51.

Material. One body chamber (GSC 67091) and (?) four fragments, from Medicine Lodge Coulée, SE 1/4, Sec. 7, Tp. 8, Rge. 3, W4th (Coll. R.W. Landes, GSC loc. 17925); one almost complete specimen (GSC 67092), from Belanger Member, NW of Old Man On His Back Plateau, Cypress Hills, Saskatchewan (Coll. G.M. Furnival, GSC loc. 10416).

Description. Adult of shell size ranging from 25-30 mm. Most phragmocone features are not available for description, but it is evident that it is relatively involute and has a strongly compressed whorl section.

At approximately the beginning of the body chamber the whorl section is rectangular, higher than wide (W/H = 0.50), with flat flanks and venter. Towards the aperture the section becomes less compressed by positive allometry of width and the flanks and venter also become slightly more convex.

The body chamber exhibits a progressive egression of the umbilical seam, but remains attached to the phragmocone, without gap between it and the mouth border.

Each one of the five to six bullae- or node-like ribs developed on the umbilical margin of the body chamber give origin to c. 2-3 relatively fine ribs. Other ribs become intercalated at different heights of the flanks, particularly within the last quarter of whorl. All ribs are prorsiradiate and weakly flexuous. Small tubercle-like clavi are developed along the ventrolateral shoulders in the middle of the body chamber. There is one every two or three ribs, and they are closely spaced conforming to an almost continuous edge on the ventrolateral shoulder. These nodes fade away near the aperture, where the venter becomes relatively more rounded and wider.

The suture is not preserved.

Comments. The number of specimens is too small and the preservation too poor to be certain about specific affinities.

Nevertheless, the uncoiling of the body chamber, the compression and the row of diminute ventrolateral tubercles, are features present in **Discoscaphites abyssinus** (Morton) as well as in **Hoploscaphites constrictus** (Sowerby).

The first species (see Morton, 1842, Pl. X, fig. 4; Meek, 1876, Pl. 35, fig. 2,4) is in general larger in size, more evolute, densely ribbed, and is characterized by more than two rows of lateral nodes (see Jeletzky and Waage, 1978, p. 1121). The material described by Elias (1933, Pl. XXXIX, figs. 2-8) under **D. abyssinus** (Morton) is too poorly preserved to be sure about its specific affinities. The best of Elias's specimens (1933, Pl. 39, fig. 3), which has been considered an ally of **Hoploscaphites nicolletii** (Morton) by Jeletzky (1962b; but see **Waage, 1968, p. 146**), differs from the Bearpaw

Formation material here described in the degree of evolution of the body chamber and the higher position of the umbilical bullae. However, Elias's specimen appears to be a macroconch while other specimens included in the same species (Elias, 1933, Pl. 39, figs. 2,4,6) seem to be microconchs, and are therefore more similar to the ones described herein. Preservation is, however, too poor to arrive at definite conclusions.

As pointed out by Jeletzky (1968, p. 51), the Canadian material exhibits strong similarity with some finely ribbed microconchs of **H. constrictus** Sowerby, such as those figured by Uhlig (1895, fig. 2), Bohm (1891, Pl. 1, fig. 10), Grossouvre (1908, Pl. XI, fig. 6-7) and Mikhailov (1951, Pl. XVII, figs. 81-82; Pl. XVIII, fig. 85). It seems, however, that the latter have a more pronounced change in density of ribbing within the last half whorl of the body chamber. Thus, the European specimens have relatively sparser ribbing in the central part of the body chamber, and a denser one near the aperture. Furthermore, some of them (cf. Bohm, 1891, Pl. I, fig. 10) have a more evolute phragmocone. These relatively small differences are further enhanced by the probable existence of sexual dimorphism (see Makowski, 1962, Text-fig. 4), since microconchs of different, but clearly related species, are usually more difficult to discriminate than the corresponding macroconchs. A more exact taxonomic assessment of this material should be made when more abundant and better preserved material becomes available.

Genus **Jeletzkytes** gen nov.

Type species: **Scaphites nodosus** Owen, 1852.

Derivation of name: After J.A. Jeletzky, in recognition of his contributions to paleontology and stratigraphy.

Diagnosis: Relatively large scaphitids, with involute phragmocone; body chamber with short shaft extending slightly beyond the phragmocone and weakly recurved hook; whorl section remaining depressed throughout the phragmocone and body chamber, or varying from depressed to slightly compressed during the ontogeny; ribs almost straight to weakly projected and flexuous; earlier representatives with stronger and sparser ribbing and bearing prominent lateral and ventrolateral tubercles on the body chamber; younger representatives with relatively finer and denser ribbing, and 2-3 rows of lateral nodes in the phragmocone, which tend to fade away on the flanks of the body chamber. Suture fairly indented, becoming more complex from older to younger species.

Comments: The type species of this new genus was originally introduced (Owen, 1852) under the broad generic name **Scaphites** Parkinson.

Even if Meek (1876) did not modify this generic assignment besides introducing the name **Discoscaphites**, he distinguished 3 different groups within **Scaphites**, i.e. **Scaphites** s. str., **S. nodosus**, and **S. trinodosus** with **S. tridens** Kner.

Nowak (1911) introduced **Acanthoscaphites** for the two last species, **Hoploscaphites** for **S. constrictus** Sowerby and **Holcoscaphites** for **S. aequalis** Sowerby. This last genus, in which he placed **S. nodosus** Owen, was, however, a junior objective synonym of **Scaphites** Parkinson. Several years later Nowak (1916) included the North American species in **Acanthoscaphites**. This action was later adopted by Diener (1916), Reeside (1927a), Elias (1933), Coryell and Salmon (1934), Warren (1934), Landes (in Russell and Landes 1940), Brown (1943) and Cobban and Reeside (1952), although some of these authors were aware that a reapprisal of the North American material was needed.

Subsequently, **Acanthoscaphites** was restricted (see Jeletzky, in Cobban and Reeside, 1952) to the group of **Acanthoscaphites tridens**, whereas the "**nodosus** group" has been placed under **Hoploscaphites** (see Gill and Cobban, 1966; Kauffman, 1977) or **Scaphites** (see Stephenson, 1941; Donovan, 1953; Jeletzky, 1960, 1962a, 1968, 1970; Birkelund, 1965, 1966).

In fact, specimens included in **Acanthoscaphites** resemble the "**nodosus** group" in the arrangement of nodes and ribs, although they have a less egressing body chamber and, usually, a ventral row of nodes. Furthermore, the suture line of **Acanthoscaphites** seems to be more denticulated than that of the early representatives of the North American group. In fact the "**nodosus** group" could represent the origin of **Acanthoscaphites** and the probably related **Rhaeboceras** Meek (see below). A probable connecting link between the "**nodosus** group" and the **Acanthoscaphites** is probably represented by **Rhaeboceras** Meek (see below).

As usually understood, the "group of **Scaphites nodosus**" has included that species as well as the "varieties" or species **brevis, quadrangularis** and **plenus** Meek, and all North American related species, i.e. **S. crassus** and **S. dupliconodosus** of Coryell and Salmon, and **S. rugosus** Stephenson.

Birkelund (1965) considered that some species from Greenland, like **S. cobbani** and **S. rosenkrantzi** Birkelund spp. are related to some of the earlier, still undescribed, representatives of this group. However, the inclusion in this group of **H. greenlandicus** (Donovan, 1953), **H. ikorfatensis** and **H. ravni** Birkelund spp., such as postulated by Atabekyan and Khakimov (1976, p. 74), does not seem appropriate. As pointed out by Birkelund (1965; see also under **Hoploscaphites**), these species belong to **Hoploscaphites** and are more probably related to **H. gilli** Cobban and Jeletzky (1965).

The similarities between some of the late representatives of the "**nodosus** group" and **H. constrictus** Sowerby have led on several occasions to identification of some representatives of the former with this latter, or other related, species (cf. Jeletzky in Cobban and Reeside, 1952; Jeletzky, 1968). In the same way the presence of the "**nodosus** group" outside North America has been repeatedly mentioned in the literature until quite recently (see Frech, 1915; Nowak, 1911, 1916; Atabekyan and Khakimov, 1976).

The similarities between some probable macroconchs, i.e. **J. brevis** and some large specimens of **H. constrictus**, between the probable microconchs, i.e. **J. quadrangularis, S. pungens** and some small representatives of **H. constrictus**, is undeniable. However, when most of the described and figured material of several species is taken into consideration it is possible to recognize two closely related groups of species. One, including **H. greenlandicus, H. gilli** and **H. tenuistriatus** is characterized by a finer and more flexuous ornament, lack of tubercles on the phragmocone, compressed phragmocone and body chamber whorls and almost nodeless macroconch body chambers. These features are evidently shared by **H. constrictus**, the type species of **Hoploscaphites**. The other group, i.e. the "**nodosus** group", usually includes larger species, which are characterized by depressed whorls, stronger ornament, lateral nodes on the body chamber and multituberculate phragmocones (see Jeletzky, 1962a; Jeletzky and Waage, 1978, p. 1121).

As partially discussed under the genus **Hoploscaphites** (see above) there are some European scaphitids, e.g. **S. tuberculatus** Giebel, "**Acanthoscaphites praequadrispinosus**" Blaszkiewicz and **A. quadrispinosus** Geinitz, that bear some resemblance, and are probably related, to the "**nodosus** group". This has been partially illustrated by

Blaszkiewicz's (1980) monograph on the Campanian-Maastrichtian ammonites of the Vistula River, Poland. There, under **Acanthoscaphites,** he has included several species, the oldest being **A.(?) tuberculatus** and the youngest **A. varians.** Some specimens (see **A. praequadrispinosus**) resemble the representatives of the "**nodosus** group" in a number of features, and also lack the ventral nodes which characterize **Acanthoscaphites** Nowak. It seems therefore probable that the "**nodosus** group" was also present in Europe at the end of the Campanian. However, for Maastrichtian time it was replaced by a lineage, i.e. **Acanthoscaphites,** unknown in North America. Regrettably the material is scarce and the suture lines of the Polish specimens have not been described or figured. Therefore it is not possible to arrive at definite conclusions about the taxonomic significance of those similarities. These and the existing differences with the North American species will be discussed below.

As evidenced in Frech's (1915, p. 560-1) amalgamation of this group with **S. binodosus** Roemer and as pointed out by Atabekyan and Khakimov (1976, p. 74) the "**nodosus** group" has perhaps stronger affinities with **Scaphites** s. str. than with **Hoploscaphites** s. str. However, in general, this genus differs (cf. Cobban, 1951b) by having a more recurved and detached hook, smaller apertural angle, absence of nodose and multinodose sculpture in the phragmocone, and a simpler suture line and shell sculpture. Nevertheless, it appears that the closest affinity with **Scaphites** is found in the oldest described representatives of **Jeletzkytes,** i.e. **J. nodosus** and **J. furnivali.** This is in agreement with Birkelund's (1965, p. 71, 96) remarks on the probable evolutionary tendencies of the "**nodosus** group". Thus, the earliest representatives or probable ancestors of this group, e.g. **S. cobbani** and **S. rosenkrantzi** Birkelund, have a small apertural angle, few ventrolateral nodes, and indistinct bullae or thickened ribs at the umbilical wall.

The GSC collections contain material from the Lea Park Formation in which **H. gilli** Cobban and Jeletzky is associated with extreme variants, (?) or an undescribed species (see Pl. 1, fig. 30) probably transitional to **J. nodosus.** This form has more prominent lateral bullae-like tubercles. Perhaps it represents the root of the **Jeletzkytes** lineage. In these specimens as well as in the early representatives of **Jeletzkytes** (i.e. **J. nodosus** and **J. furnivali**) lateral and ventrolateral tubercles are restricted to the last part of the phragmocone and body chamber, whereas in later species (i.e. **J. cf. brevis** ♀, **J. cf. crassus** ♀) the tubercles are more extensive on the inner whorls of the phragmocone. Some species, i.e. **J. criptonodosus** sp. nov. contain additional rows of nodes.

The suture also appears to have evolved from relatively simple to more incised with slender saddles and narrow lobes, becoming similar to some of those found in the multituberculate scaphitids excluded from **Discoscaphites** by Jeletzky and Waage (1978; see Meek, 1876, Pl. 36, fig. 28; Wright in Arkell et al., 1957, fig. 256-2c).

Thus, the latest representatives of the "**nodosus** group" are probably transitional to some of these multituberculate scaphitids which bloomed in the same area during Maastrichtian time (Jeletzky and Waage, 1978, p. 1121).

The study of the latter species is underway by K.M. Waage and a review of the older scaphitids is beyond the scope of the present paper. A more comprehensive treatment of the origin and descendents of the Bearpaw scaphitids which presently are included in **Jeletzkytes** awaits further study.

Jeletzkytes nodosus (Owen, 1852)

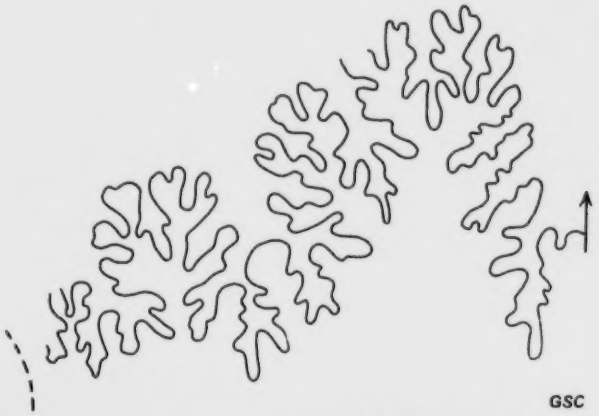
Plate 2, figures 1-8; Text-figures 5-6, 7a

1852 **Scaphites (Ammonites?) nodosus** (N.S.), Owen, p. 581, pl. VIII, figs. 4-4a.
?1859 **Scaphites nodosus** var. Meek, p. 185, pl. 2, figs. 7-8.
?1880 **Scaphites nodosus** Whitfield, p. 441, pl. 13, fig. 12.
1885 **Scaphites nodosus** Owen, Whiteaves, p. 52 (part).
?1892 **Scaphites nodosus** Whitfield, p. 261, pl. XLIV, figs. 13-14.
?1896 **Scaphites nodosus** Gilbert, pl. LXV, fig. 2, ?non pl. LXIII, fig. 3.
?1899 **Scaphites nodosus** Meek, Logan, pl. XXII, fig. 2, pl. XXIII, figs. 1-4, 6-12.
?1907 **Scaphites nodosus** Owen?, Weller, p. 824, pl. CVII, figs. 1-2 (reproduction of Whitfield, 1892).
1917 **Scaphites nodosus** Owen, Dowling, p. 32, pl. XXXII, fig. 3 (reproduction of Owen, 1852).
1927 **Acanthoscaphites nodosus** (Owen), Reeside, p. 32.
?1933 **Acanthoscaphites nodosus** Say, Elias, p. 329, pl. XXXVIII, figs. 1a-b, 2, ?3.
1940 **Acanthoscaphites nodosus** Owen, Landes in Russell and Landes, p. 177-8.
1970 **Scaphites nodosus** Owen, Jeletzky, pl. XXVII, figs. 7a-b.

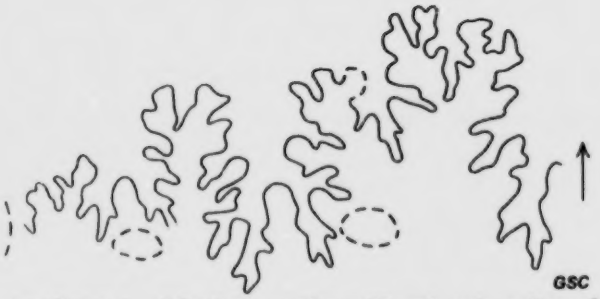
Holotype: By monotypy, the almost complete specimen figured by Owen, 1852 on Pl. VIII, fig. 4, and here refigured on Plate 2, figures 1-3, from "Sage Creek, tributary of the Cheyenne", Gurley coll. (FM No. 6381).

Diagnosis: **Jeletzkytes** of large size with body chamber extending beyond the phragmocone; whorl section with strong expansion, depressed throughout, with sides and venter rounded on the phragmocone but becoming flattened on the body chamber; surface of inner whorls of phragmocone without tubercles. Last half whorl of phragmocone and body chamber ornamented with strong and sharp ribs and two rows of tubercles, one in the ventrolateral shoulder and another in the middle of the flanks. Suture rather simple, with asymmetrically bifid lateral lobe almost as deep as the ventral lobe, and approximately two auxiliary lobes before the umbilical margin.

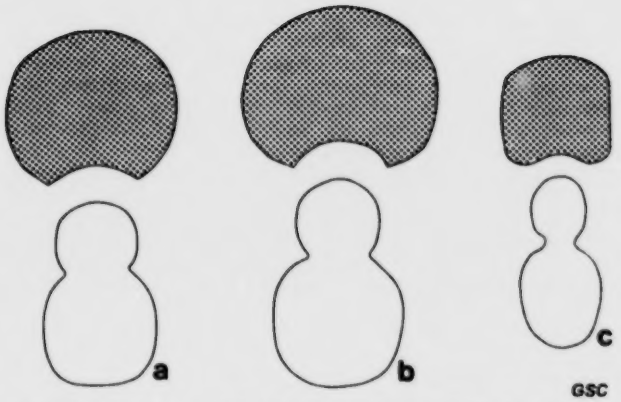
Material: The holotype; ?one complete, but partially crushed specimen (GSC no. 5369/b) and one almost complete specimen (GSC no. 5369/a) from Elbow of Saskatchewan River (J. Macoun coll. 1879 figured by Jeletzky, 1970; GSC loc. 97990).



***Text-figure 5. Jeletzkytes nodosus** (Owen), holotype FM 6381, suture line at D = c. 43 mm, H = 21 mm and W = 25 mm (see Plate 2, fig. 1-3).*



*Text-figure 6. **Jeletzkytes nodosus** (Owen), suture line of specimen GSC no. 5369 at H = 26.4 mm and W = 27.8 mm (see Plate 2, fig. 4-8).*



*Text-figure 7. a) **Jeletzkytes nodosus** (Owen), holotype FM 6381, cross section (see Plate 2, fig. 1-3); b) J. aff. **nodosus** (Owen), cross section of specimen UA 748 (see Plate 3, fig. 2-6); c) J. **furnivalli** sp. nov., cross section of holotype, GSC no. 67093 (see Plate 4, fig. 7-9). Body chambers stippled; X0.50.*

Description: Shell of relatively large size, with length of mature specimens ranging between 70 and 103 mm.

Phragmocone strongly involute (U/D < 0.10) with a subquadratic whorl section where W is larger than H (w/h = 1.08-1.11). Body chamber deflected, extending slightly beyond the phragmocone, with a shaft, which is relatively short and amounts to 0.26-0.28 of the total length. Whorl section subrounded with higher values of W than H and becoming more depressed towards the aperture (W/H = 1.13-1.15). The flanks and venter are slightly flattened and the insufficiently known aperture angle appears to be large.

Ornament is formed by narrow, well marked and sharply raised ribs, and two rows of lateral and ventrolateral tubercles which are restricted to the last half whorl of the phragmocone and the body chamber.

On the last whorl of the phragmocone c. 15 ribs cross the umbilical shoulder either in an almost straight fashion or with a weak backward projection. On the flank they bend forward and backward again forming a shallow adapical concavity in the middle. Secondary ribs are intercalated, or originate from primaries, at different heights. Wherever lateral and ventrolateral tubercles are present, two or three secondaries arise from them. Some ribs, however, become intercalated in the upper third of the flanks without showing a clear connection to primaries or tubercles.

Lateral and ventrolateral tubercles appear half a whorl before the end of the phragmocone. At first they are small and weak but gradually become strong and clavate. They number respectively 4 and 6-7 before the beginning of the body chamber.

Density of ribbing increases throughout the body chamber and the secondaries present in the last whorl of the holotype amount to c. 125. They also become adaperturally projected forming a weak adapical concavity. In the middle of the flank or slightly below there is a row of prominent nodes where ribs from the upper and lower part of the flank are usually bundled together. On the ventrolateral margin there are clavi, which can be as large as or larger than the lateral nodes. The tubercle size increases steadily to the middle of the body chamber. From there onwards the size of the lateral nodes remains almost constant while that of the ventrolateral clavi decreases.

The aperture is unknown. The suture (text-figs. 5-6) is rather simple but incised. The lateral lobe is asymmetrically bifid and almost as deep as the ventral lobe. The first auxiliary lobe is trifid. The first lateral saddle is wide and a deep incision divides it asymmetrically; two asymmetrically bifid auxiliary lobes are present above the umbilical margin.

Comments: **J. nodosus** (Owen) is a poorly known species, which has been frequently mentioned in the literature but rarely figured or described. It was originally based on a single specimen found at Sage Creek, S. Dakota. This specimen was only figured in its lateral view (Owen, 1852, Pl. VIII, fig. 4), and thought to be lost (cf. Stephenson, 1941, p. 426). It is photographically figured here for the first time.

The morphological variation of this species remains unknown to the writer due to the unavailability of topotype material. Some specimens found in the Bearpaw Formation of Canada seem to be closely related to this species, but their number and preservation are not enough to adequately assess the taxonomic significance of the differences they exhibit with respect to the holotype of this species. A similar situation exists with regard to the taxonomic status of published material, mainly from United States, which has been ascribed to **J. nodosus** or to closely related species.

In spite of all these shortcomings it seems useful to attempt some comparisons.

The specimen from the South Branch of the Saskatchewan River, tentatively considered by Meek (1859) as a variety of this species is lost. From the reproductions (Pl. 2, figs. 7-8), however, it seems to have finer ribbing and lack lateral nodes on the body chamber. In these features, therefore, it appears to be closer to **J. brevis** ♀.

Of the two specimens included by Whitfield (1880, 1892) in this species, the first one (Whitfield, 1880, Pl. XIII, fig. 12, USNM 12284), which comes from the Black Hills of Dakota, differs from the holotype in the more compressed whorl section, the less conspicuous lateral tubercles, which are also

closer to the umbilical margin, and the existence of ventrolateral tubercles at an earlier stage of the phragmocone. This specimen is in fact intermediate to **J. brevis** (Meek) and **J. quadrangularis** (Meek) in whorl thickness, number of secondaries and prominence, distance to the umbilical margin of the lateral row of tubercles, and length of the shaft.

The other specimen included with the species by Whitfield (1892, Pl. 44, figs. 13-14; cf. Weller, 1907) comes from New Jersey and is too poorly preserved to identify accurately. The lateral nodes, however, are smaller than those found in **J. nodosus**, and its inclusion in this species has already been discounted by Reeside (1962, p. 126).

Of the material mentioned, but not figured, by Whiteaves (1885, p. 52) one of the specimens (i.e. that found by J. Macoun in 1879 at the Elbow of the South Saskatchewan), even if crushed, is similar to the holotype in ornament and whorl section, but differs in that it appears to have ventrolateral nodes at an earlier stage. Also the shaft seems to be larger and the apertural angle smaller. However, these differences could in part be due to deformation. The specimen found by R.G. McConnell in 1882, at the South Saskatchewan, opposite the mouth of the Swift Current Creek, and here figured on Plate 3, figure 1, agrees in size, number and position of the lateral tubercles, but it has a sparser ribbing, a compressed whorl section and the tubercles also seem to be present at earlier growth stages.

Of the two specimens figured by Gilbert (1896), coming from the "Tepee Zone of the Pierre shale", only that of Plate LXV, figure 2 (USNM 28363) has some resemblance to **J. nodosus** (Owen), although it is slightly larger than the holotype, more compressed, and has a shorter shaft. Furthermore, its apertural angle (121°) is probably smaller, the bundles of ribs centered in the lateral tubercles form elongated swellings, and the ventrolateral nodes seem to extend to the inner whorls. What is visible of the phragmocone of this specimen bears some resemblance to the holotype of **Scaphites reesidei** Wade (1926, Pl. 61, fig. 3-6, USNM 73112) from the Coon Creek Tongue of the Ripley Formation, Tennessee.

Gilbert's smaller specimen (Gilbert, 1896, Pl. LXIII, fig. 3), is a microconch whose specific status cannot be clarified here.

The specimen reproduced graphically by Logan (1899, Pl. XXII, fig. 2) under **S. nodosus** Owen has a greater number of secondaries and ventrolateral nodes than the holotype of the species. The inner row of tubercles is also closer to the umbilical margin. In fact, this specimen could belong in **J. brevis** or **J. plenus**. Under the only catalogue number mentioned by Logan (1899, p. 210, No. 3653) the Field Museum has two specimens which clearly belong to the latter-mentioned species.

Several fragments from the Upper Weskan and Lake Creek Members of the Pierre Shale of Wallace County, Kansas, ascribed to this species by Elias (1933, Pl. XXXVIII, fig. 1-3) may belong there.

Thus far, sexual dimorphism, apparent in other scaphitids, cannot be found within this species (see Cobban, 1969). The holotype is a relatively large specimen, which may be a macroconch, but it lacks the clear umbilical swelling found in most macroconchs of this group (see below). Here the shaft's umbilical margin is characteristically evenly curved. Nevertheless, the small specimen (see Pl. 2, figs. 4-8), a probable microconch, appears to have an umbilical margin with a more even curvature throughout the body chamber.

The differences between **J. nodosus** and **J. brevis** and **J. plenus** Meek spp. appear to be fairly obvious. **J. nodosus** is characterized by its curved umbilical margin and sparser ribbing and the consistent presence of centro- and ventrolateral rows of tubercles. The other two species have more numerous tubercles and secondaries, which tend to fade away on the flanks of the body chamber. Their lateral nodes are relatively smaller and closer to the umbilical margin and almost absent on the body chamber of extremely gibbous specimens. Furthermore, their tubercles are present in the inner whorls of the phragmocone. Additionally, these last two species clearly exhibit sexual dimorphism, the macroconchs having swelling body chambers and microconchs compressed whorl sections and lateral rows of nodes on the umbilical margin. Such morphological differences occur over slightly different stratigraphic ranges, e.g. **J. nodosus** appears below the first record of the other species (cf. Landes, in Russell and Landes, 1940, p. 187; Gill and Cobban, 1966; Jeletzky, 1968).

Another close relative of **J. nodosus** is **J. rugosus** (Stephenson, 1941, p. 425, Pl. 89, figs. 15-18, USNM 77305) from the Nacatoch Sand of the Navarro Group of Texas. However, the only figured specimen of this species differs in having a shorter shaft, coarser ornament, slightly larger size difference between ventrolateral and lateral tubercles, more internally situated lateral tubercles and presence of nodes at earlier stages.

The specific identity of **J. nodosus** (Owen) and the European early Campanian **Scaphites binodosus** Roemer (1841, p. 90, Pl. 13, fig. 6; cf. Schlüter, 1872, Pl. 24, figs. 4-6) proposed by Frech (1915, p. 560) is unacceptable. As already noted by Nowak (1916), the latter species has strong bullae-like ribs on the flanks, which connect the inner and outer tubercle rows, and also has a smaller apertural angle.

The **J. nodosus** group appears to have close affinities with the European material usually described under **"Scaphites compressus** Roemer" (1841, p. 90, Pl. XV, fig. 1, = **Scaphites tuberculatus** Giebel, 1849, p. 20), as was already suggested by Meek (1876). However, due to the poor knowledge of both species and the nomenclatural problems surrounding **S. tuberculatus** (see Birkelund, 1965) this relationship remains obscure.

As pointed out by Schmid and Ernst (1975, p. 336), Roemer's original figure is, according to Frech (1915, p. 567; see explanation to fig. 14), a reconstruction based on two different specimens. Thus, the features exhibited by that species show it to differ from **J. nodosus** in its more compressed whorl section, longer shaft, denser and finer ribbing on the body chamber, lateral row of tubercles closer to the umbilical shoulder, smaller and more numerous tubercles on the body chamber, and smaller apertural angle. These differences are also shown by the specimen figured by Frech (1915, p. 567, fig. 14) and Blaszkiewicz (1980, Pl. 16, fig. 1-3,5,8; Pl. 19, fig. 1,4-5; Pl. 20, fig. 4-5). As pointed out by Schmid and Ernst (1975, p. 336), and contrary to Birkelund's (1965, p. 102) statement, this specimen is not a reproduction of Roemer's original, but a similar reconstruction based on two different specimens from that author's collection. There is, however, as indicated by Schmid and Ernst (1975), a striking difference with respect to Roemer's figure, i.e. in Frech's reconstruction the two rows of tubercles are restricted to the shaft and hook and seem to be absent from the phragmocone. The restriction of tubercles to the body chamber is corroborated by the only specimen figured by Schmid and Ernst (1975, Pl. 3, fig. 1) and that of Mikhailov (1951, Pl. XVI, figs. 74-75). These data appear to conflict with Birkelund's (1965, p. 167) and Blaszkiewicz's (1980, p. 38) conceptions of **S. tuberculatus** (see also Plate 4, figures 5,6).

Geinitz (1849-50, Pl. VII, fig. 2; Pl. VIII, fig. 2), Nowak (1911, Pl. XXXIII, fig. 28), Mikhailov (1951, Pl. 19, fig. 93) and Blaszkiewicz (1980, Pl. 22, fig. 1-10) have assigned to **Acanthoscaphites quadrispinosus** (Geinitz) some variants of **A. tridens** usually characterized by the absence of ventral nodes. Because of the presence of only two rows of nodes this Maastrichtian species resembles **J. nodosus** (Owen) (see Lopuski, 1911, p. 122; Nowak, 1911, p. 577; 1916, p. 39,62,63). However, as it happens in all true **Acanthoscaphites**, the egression of the body chamber is smaller. This results in its remaining in contact with the preceding whorl. Furthermore the ornament is stronger, sparser and more irregular and the ventrolateral tubercles become progressively more prominent towards the aperture. **J. nodosus** exhibits the closest affinities to the late Campanian material from Poland described under **Acanthoscaphites praequadrispinosus** Blaszkiewicz (1980, p. 38, Pl. 19, fig. 2-3, 6-8; Pl. 20, fig. 1-3, 6-8; Pl. 21, fig. 1-6). This last species, however, appears to differ in its larger size, more compressed whorl section, smaller apertural angle, less flexuous ribs and presence of lateral tubercles closer to the umbilical margin.

Dimensions (in mm):

	L	D	U	h	w	l
1. Holotype, F.M. 6381	103.2	39.7	5.3(0.09)	37.0(0.62)	40.0(0.67)	27
2. GSC 5369	79	47	4.2(0.09)	20.6(0.63)	33.0(0.70)	22

	l/L	H	W	w/h	W/H	A	P	S	In	Ex
1. F.M. 6381	0.26	43.7	49.5	1.08	1.13	-	22	125	8	16
2. GSC 5369	0.28	34.2	39.3	1.11	1.15	-	-	80	7	9

restricted to the last half whorl. There are c. 12-16 lateral and c. 17-18 ventrolateral tubercles on the last whorl. Initially they are small and weak, but their size increases steadily to the middle of the body chamber, from where it tapers towards the aperture. The ventrolateral tubercles become spinose and clavate, and are usually larger than those on the flanks.

The aperture is weakly constricted and has an angle of c. 135°.

The suture is incised with a narrow asymmetric lateral lobe, as deep as the ventral lobe, and a narrow and elongated first lateral saddle.

Comments: The specimens described herein are rather similar to the holotype of **J. nodosus** (Owen), but differ in the relatively smaller and more numerous lateral tubercles, which are also variable in size, presence of tubercles at an earlier growth stage, an apparently slower expansion of the whorl, sharper and less flexuous ribs, and lesser detachment of the body chamber. It is difficult, however, to assess the taxonomic significance of these differences, as there is no information about the stratigraphic position of these specimens, and as the range of morphologic variation of **J. nodosus** remains unknown.

Dimensions (in mm):

	L	D	U	h	w
1. U.A. 748	110.7	68.4	4.6(0.07)	42.3(0.62)	45.3(0.66)
2. U.A. 03944	101	c.60	10.4(0.17)	35.2(0.59)	39.8(0.66)

	l	l/L	H	W	w/h	W/H	A	P	S	In	Ex
1. U.A. 748	25	0.23	42.8	54.8	1.07	1.28	135	23	110	12	17
2. U.A. 03944	26.8	0.27	-	-	1.13	-	-	-	100	16	18

Jeletzkytes aff. nodosus (Owen, 1852)

Plate 3, figures 2-6; Plate 4, figures 1-2, Text-figure 7b

Material: One complete mature specimen from ?north side of Milk River, near Groton, Tp. 3, Rge. 10, W4th (Coll. J.A. Allen, U.A. 748); one incomplete specimen with crushed end of body chamber from an unknown locality in Alberta (U.A. 03944).

Description: Shell relatively large, with a length of 100-110 mm.

Phragmocone involute (U/D = 0.07-0.17), with a subrounded whorl section where W is larger than H (w/h = 1.07-1.13). Body chamber deflected, extending slightly beyond the phragmocone, with a shaft relatively short amounting to 0.23-0.27 mm of the total length. Whorl section subrounded with higher values of W than H, becoming more depressed towards the aperture (W/H = 1.28 mm).

Ornament is formed by well marked ribs and two rows of lateral and ventrolateral tubercles which are present, at least, on the last phragmocone whorl and the body chamber. On the last phragmocone whorl c. 13 ribs cross the umbilical shoulder. They bend forward and backwards again on the flank forming a shallow adapical concavity. Secondary ribs originate from the tubercles, or become intercalated in the upper third of the flanks. On the last whorl 100-110 secondaries cross the venter and form an adapical concavity.

Tubercles are already present on the last whorl of the phragmocone. On the ventrolateral margin they seem even to appear at earlier stages, while on the flanks they are

Jeletzkytes cf. nodosus (Owen, 1852)

Plate 3, figure 1

1885 **Scaphites nodosus** Owen, Whiteaves, p. 52 (in part).

Material: One incomplete and partially distorted specimen (GSC no. 5367) from South Saskatchewan River, opposite mouth of Swift Current Creek, Saskatchewan (coll. R.G. McConnell, 1882, GSC loc. 97991).

Description: Shell of relatively large size, with a total length of c. 111 mm. The end of the body chamber and most of the phragmocone are missing.

Body chamber deflected, extending slightly beyond the phragmocone, with a relatively short shaft amounting to c. 0.2 of the total shell's length. Whorl section compressed, partly due to crushing, with higher values of H than W (W/H = 0.63 mm). The flanks and venter are flattened.

The ornament consists of narrow, sharp ribs and two rows of tubercles. The ribs, which are half as wide as the interspaces, are almost radial on the flanks and weakly flexuous. They become prorsiradiate on the upper part of the flanks and cross the venter with a slight forward projection. Secondary ribs are intercalated at different heights or are born from the lateral and ventrolateral tubercles. There are about 94-95 secondaries on the last whorl.

Tubercles are already present at least on the last half whorl of the phragmocone. There are c. 10 lateral and c. 21 ventrolateral tubercles on the last whorl. They increase in

size towards the middle of the shaft from which point the ventrolateral tubercles decrease in size. The largest ventrolateral tubercles become clavate and are larger than those on the flanks.

The aperture and suture line are not preserved.

Comments: This specimen resembles the holotype of **J. nodosus** (Owen) in number and position of tubercles, but differs in its compression, sparser and sharper ribs and the apparent presence of tubercles at earlier growth stages. In the compressed whorl section this specimen is closer to **"Acanthoscaphites" praequadrispinosus** Blaszkiewicz (1980), but it appears to differ in the more flexuous and sparser ribbing, and in the position of the lateral tubercles.

Jeletzkytes furnivali sp. nov. ? ♂

Plate 4, figures 3-4, 7-9, Text-figures 7c, 8

Holotype: The complete specimen figured on Plate 4, figures 7-9 (GSC 67093), from 183.0 m (600 ft) below top of Bearpaw Formation at Cypress Hills, 1/4 Sec. 5, Tp. 10, Rge. 28, W3rd, Saskatchewan (Coll. G.M. Furnival, 1941; GSC loc. 16316).

Derivation of name: The species is named for G.M. Furnival, who made extensive collections and studied the stratigraphy of the Cypress Hills area.

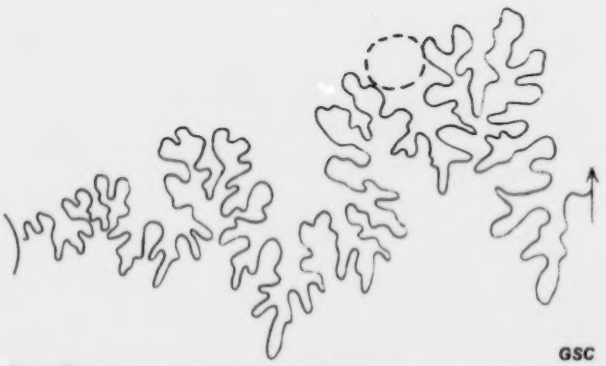
Diagnosis: Medium-sized shell, with body chamber extending slightly beyond the phragmocone; whorl section compressed, subrounded to subrectangular throughout; apertural angle c. 107°; ribbing flexuous becoming coarser and sparser from the phragmocone to the body chamber; approximately eleven small tubercles on the last half whorl of the phragmocone becoming larger and clavate on the middle of the body chamber and then decreasing in size towards the aperture. Relatively small bullae, which develop into nodes, on the lower third of the flank. They form elongate swellings with the ribs branching from their tops. Suture relatively complex, with asymmetrically trifid lateral lobe deeper than the ventral lobe.

Material: The holotype (GSC 67093); and one phragmocone (GSC 67094) from almost the same locality and level at Cypress Hills 1/4 Sec. 7, Tp. 10, Rge. 28, W3rd, Saskatchewan (Coll. G.M. Furnival; GSC loc. 16330).

Description: The holotype is c. 82.9 mm in length.

Phragmocone involute (U/D = 0.10) with a rounded subrectangular whorl section where h is larger than w (w/h = 0.79). The body chamber extends slightly beyond the phragmocone, and has a relatively short shaft which amounts to c. 0.25 of the total length. The whorl section remains subrectangular with higher values of H than W, but it becomes less compressed towards the aperture (W/H = 0.85). The flanks are almost flat and parallel and the venter is broadly curved near the aperture but somewhat flattened within the shaft. The umbilical wall has no swelling and is curved almost to the aperture. The apertural angle is c. 107°.

The last whorl of the phragmocone has c. 17 primaries, which are branching at different heights. Near the umbilical margin they are prorsiradiate, but bend backwards in the middle part of the flank to become radial as they reach the venter. On the ventrolateral margin there is a row of small nodes, c. 11 in the last half whorl, from which usually two secondary ribs are born. There are c. 55 straight secondary ribs on the venter of the last half whorl of the phragmocone. In the middle of the flank 2 or 3 ribs also have a barely visible node-like thickening.



GSC

Text-figure 8. ***Jeletzkytes furnivali*** *sp. nov., suture line of holotype, GSC no. 67093, at H = 24.4 mm and W = 21.5 mm (see Plate 4, fig. 7-9).*

On the body chamber the ribs are sharp and flexuous, and a lateral row of nodes develops besides the ventrolateral ones. The position of the lateral nodes varies between the outer part of the lower third of the flank in the middle of the shaft and almost the umbilical margin near the aperture. They begin as thickenings of the ribs, i.e. bullae, and increase progressively in size to become rounded nodes at the end of the body chamber. The ventrolateral tubercles are larger and also increase in size reaching a maximum in the middle of the shaft where they become clavate; from there onwards they become progressively smaller.

There are c. 8 lateral and c. 11 ventrolateral tubercles on the body chamber. One or two of every four of the prorsiradiate primary ribs merge in the lateral tubercles or bullae, from which two to four secondaries emanate. These rib bundles form conspicuous swellings on the lower part of the flanks. Further divisions can occur in the middle and upper part of the flank, where all ribs bend backwards forming adapical concave arches. About 3 of these ribs merge in the ventrolateral tubercles, out of the ventral side of which originate, in turn, four ribs each. All ribs, which count about 73, cross the venter of the body chamber forming a shallow adapical arch.

The suture (text-fig. 8) is relatively complex. The first lateral lobe is asymmetrically trifid and deeper than the ventral lobe. The second lateral lobe is asymmetrically bifid and not as deep as the ventral lobe. The lateral saddles are very strongly incised. The first lateral saddle is rather wide and divided into two main branches, with the ventral branch being larger than the dorsal. The second lateral saddle is deeply incised and divided into three main branches. Two (?three) asymmetrically trifid and oblique auxiliary lobes are present above the umbilical margin.

Comments: **Jeletzkytes furnivali** sp. nov. is closely related to **J. nodosus** (Owen) and **J. brevis** (Meek). From the first it differs in having a compressed whorl section and more flexuous ribs throughout the ontogeny. It also has a more densely ribbed phragmocone while on the body chamber the ribbing becomes relatively sharper and sparser. The lateral nodes and bullae are relatively closer to the umbilical margin while the apertural angle is smaller. The suture line has a more deeply and complexly denticulated, asymmetrically trifid lateral lobe which is much deeper than the ventral lobe.

J. brevis (Meek) has a more compressed whorl section, body chamber with finer and denser ribbing and less conspicuous and numerous lateral nodes, and a larger number of ventrolateral tubercles. The apertural angle is also larger.

A complete phragmocone with a beginning of the body chamber preserved (GSC 67094) is from almost the same locality and probably from the same level as the holotype. It is here tentatively included in **J. furnivali**. It resembles the holotype in the compressed whorl section, number and type of ribs and the ventrolateral nodes. It also has small nodes in the outer part of the lower third of the flank at the end of the phragmocone, which in the fragment of the body chamber seem to be coincident with bullae-like swellings. The ventrolateral nodes also become stronger at the beginning of the body chamber. This specimen, however, differs in being more compressed (W/H = 0.62- vs. 0.79), involute (U/D = 0.07 vs. 0.10) and in having slightly coarser ribs. Although the lateral lobe is deeper than the ventral one, the suture line contains oblique and retracted auxiliaries. This specimen also bears some resemblance to **"Scaphites reesidei** Wade" (1926, p. 183, Pl. 61, fig. 3-6), although it has more flexuous ribs and seems to be more compressed. The suture line also is simpler in Wade's specimen, with a wider first lateral saddle and a lateral lobe which is as deep as the ventral one. In fact, Wade's species strongly resembles the phragmocone of the specimen from the Hygiene Sandstone of Colorado included by Gilbert (1896, Pl. 65, fig. 2) in **J. nodosus** (Owen) which differs from **J. nodosus** and seems to bear a greater resemblance to **J. furnivali** sp. nov. The number and density of ribbing is, however, smaller in **J. furnivali**, which also has relatively stronger and less numerous ventrolateral nodes. This species resembles **"Acanthoscaphites" praequadrispinosus** Blaszkiewicz (1980, see Pl. 20, fig. 7) in compression, apertural angle, egression of the body chamber and the two rows of tubercles. It differs in the more flexuous ribbing and the presence of rib bundle-like swellings on the lower part of the flanks.

Dimensions (in mm):

	L	D	U	h	w
Holotype,					
1. GSC 67093	82.5	51.3	5.0(0.10)	29.5(0.58)	23.4(0.46)
2. GSC 67094	-	38.5	4.2(0.07)	36.3(0.62)	22.5(0.38)

	l	l/L	H	W	w/h	W/H	A	P	S	In	Ex
1. GSC 67093	21	0.23	39.7	33.7	0.79	0.83	107°	25	110	8	21
2. GSC 67094	-	-	-	-	0.62	-	-	-	-	-	-

Jeletzkytes cf. crassus (Coryell and Salmon, 1934)

Plate 7, figures 3-5; Plate 8, figures 1-6;
Plate 9, figures 3-4; Plate 22, figures 2-4;
Text-figures 9-12, 13b-c

?1885 **Scaphites subglobosus** (n.sp.), Whiteaves, p. 52, Pl. 8, figs. 2-2a (non Pl. 7, fig. 3; Pl. 8, figs. 1-1a).
?1917 **Scaphites subglobosus** Whiteaves, Dowling, p. 32, Pl. XXXI, figs. 2-2a (reprint of Whiteaves, 1885, Pl. 8, figs. 2-2a) (non Pl. 31, fig. 1-1a).
?1933 **Scaphites plenus** Meek, Elias, p. 314, Pl. XXXVI, figs. 1-2; Pl. XXXVII, fig. 1; Pl. XXXIX, fig. 1; Pl. XL, figs. 3-6).
?1934 **Acanthoscaphites nodosus crassus**, new variety, Coryell and Salmon, p. 15, figs. 10-11.
?1934 **Acanthoscaphites duplico-nodosus**, new species, Coryell and Salmon, p. 17, figs. 12-13.

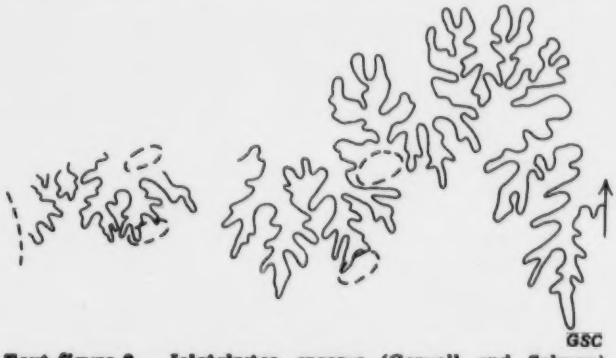
Material: The phragmocone figured by Whiteaves (1885, Pl. 8, figs. 2-2a) under **"Scaphites subglobosus"**, and one unfigured inner whorl (GSC no. 5339a,c), from Old Wives Creek, Tp. 10, Rge. 11, W3rd, Saskatchewan (Coll. R.G. McConnell, 1884, GSC loc. 97992); one complete phragmocone with the final part of the body chamber (GSC 67095), from 150' above Bentonite No. 8 in the Manyberries section, Cypress Hills, Alberta (Coll. R.W. Landes; GSC loc. 19429); one complete phragmocone with the final part of the body chamber (GSC 67096), from Belanger Member, Cypress Hills, NE Sec. 16, Tp. 3, Rge. 25, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10407).

Description: At about 30 mm of diameter the phragmocone is involute (U/D = 0.16-0.18) and globose with a depressed whorl section (w/h = c. 1.22). The umbilical wall is high and steep with a rounded umbilical margin. The flanks are almost regularly convex and gradually pass into a widely rounded venter. Primary ribs, c. 9 per half whorl, cross the umbilical margin and flanks with a slight forward projection. They are sharp and twice as narrow as the interspaces separating them. Secondary ribs become intercalated on the middle and upper part of the flanks and all ribs cross the venter, where they number c. 27 per half whorl, forming a shallow adapically concave bow. Small nodes are present on every 2nd or 3rd rib on the lower third and ventrolateral shoulder of the flank.

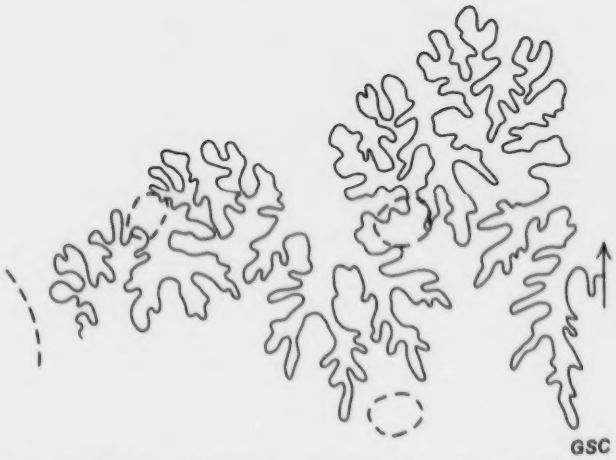
Up to the end of the phragmocone (c. 63-78 mm of diameter) the umbilical diameter becomes smaller (U/D = 0.10-0.13) and the whorl section slightly more depressed (w/h = 1.23-1.35). Ribbing is relatively finer and denser, as well as more flexuous. The total number of primaries and secondaries amounts to c. 18-20 and c. 60 per whorl. The ventrolateral nodes, c. 10-12 per half whorl, exhibit a steady increase in size, while the lateral ones remain relatively smaller.

Length of mature specimens appears to range between c. 96 and 118 mm. The body chamber extends only slightly beyond the phragmocone, where the last suture forms an angle of c. 145° with the axis of the shaft. The height and width of the body chamber increase from the end of the phragmocone to the middle of the shaft, where they reach a maximum at a prominent swelling. Farther towards the aperture the width and height of the whorl section decrease steadily. The aperture is, therefore, constricted and the apertural angle is c. 118-119°.

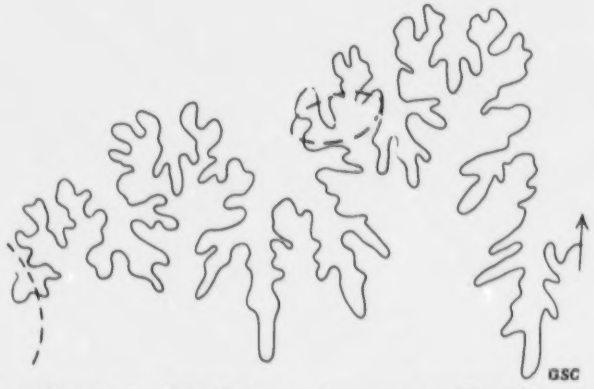
Ribs on the body chamber are fine and sharp; on the inner margin of the shaft they are rursiradiate, but become prorsiradiate on the flanks. They cross the venter with a shallow adapically concave arch. Secondaries are intercalated at different heights and some are born from small lateral nodes. Most of them, however, originate from a division of primaries on the upper part of the flanks. Secondaries also emanate from the ventrolateral tubercles. There are over 150 ribs on the venter in the last whorl.



Text-figure 9. ***Jeletzkytes crassus*** *(Coryell and Salmon), suture line of holotype, AMNH 24234, at H = 34 mm and W = 43.6 mm (see Plate 9, fig. 3-4).*



Text-figure 10. ***Jeletzkytes crassus*** *(Coryell and Salmon), suture line of the AMNH 24235, holotype of* ***"Acanthoscaphites duplico-nodosus"*** *Coryell and Salmon, at H = 24.8 mm and W = 28.3 mm (see Plate 8, fig. 5-6).*

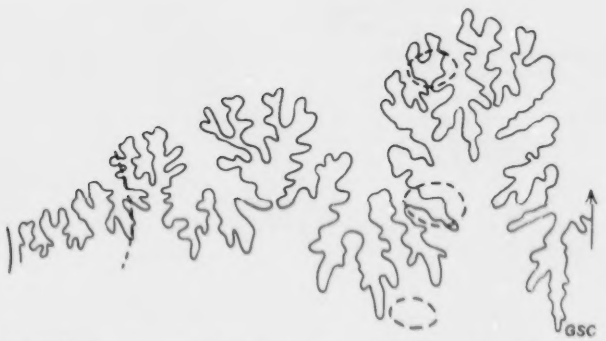


Text-figure 11. ***Jeletzkytes*** *cf.* ***crassus*** *(Coryell and Salmon), suture line of specimen GSC no. 67095, at H = 16.3 mm and W = 19.5 mm (see Plate 7, fig. 3-5).*

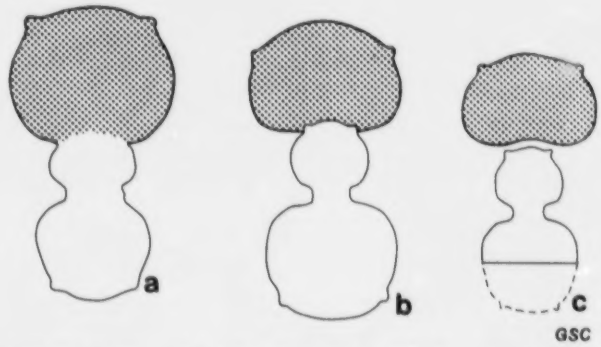
The row of lateral nodes becomes discontinuous on the body chamber where only 3 or 4 radially elongated bullae-like nodes are present. The ventrolateral tubercles attain an even larger size, reaching a maximum in the middle part of the shaft, from where they decrease towards the aperture.

The suture (text-figs. 9-12) is complex. The lateral lobe is asymmetrically bifid and as deep as the ventral lobe. The second lateral lobe is asymmetrically trifid and half as deep as the first. The first auxiliary lobe is located on the umbilical shoulder. The first lateral saddle varies in width and is divided into two main branches, the ventral one being larger than the dorsal. The second lateral saddle is narrower and divided into 3 branches of different sizes. Two more (i.e. second and third) asymmetrically bifid to trifid auxiliary lobes are visible above the umbilical margin.

Comments. The material here described bears a strong resemblance, in size, inflation and ornament to the holotype of **Jeletzkytes crassus** (Coryell and Salmon, 1934). That



Text-figure 12. ***Jeletzkytes*** *cf.* ***crassus*** *(Coryell and Salmon), suture line of specimen GSC no. 5339a, at H = 25.8 mm and W = 32.5 mm (see Plate 22, fig. 2-4).*



Text-figure 13. *a)* ***Jeletzkytes plenus*** *(Meek), cross section of the holotype, USNM 364 (see Plate 9, fig. 1-2); b)* ***Jeletzkytes crassus*** *(Coryell and Salmon) cross section of the holotype, AMNH 24234 (see Plate 9, fig. 3-4); c)* ***Jeletzkytes*** *cf.* ***crassus*** *(Coryell and Salmon), cross section of specimen GSC no. 67096 (see Plate 8, fig. 1-4). Body chambers stippled; X0.40.*

species was introduced without indication of its distinctive features with respect to the closely related and possibly senior synonym (see Cobban, 1969, p. 11) **J. plenus** (Meek). Study of the types, however, suggests that **J. plenus** (Meek) (see Plate 9, figs. 1-4; text-fig. 13a) differs in having a more involute phragmocone, less depressed and rounded flanks, an incipient third row of nodes in the phragmocone, and a body chamber with fewer and stronger ventrolateral tubercles. On that basis it seems advisable to accept both species as valid, although more material is necessary to establish the ranges of their morphological variability and hence definite validity.

The incomplete and partially crushed holotype of **"Acanthoscaphites duplico-nodosus"** Coryell and Salmon (1934) (here refigured on Pl. 8, figs. 5-6) represents probably the inner whorls of **J. crassus.** Its distinctive features, i.e. "its paired nodes and characteristic sutural features" do not seem to be consistent. Only two pairs of nodes are visible on the holotype, which also exhibits unpaired tubercles. The suture line has relatively narrower and more incised elements, but according to the material included in **J. crassus** herein those features are somewhat variable.

Features similar to those of **J. crassus** are also present in the specimen described by Whiteaves (1885) as "**Scaphites subglobosus**" (Whiteaves, 1885, p. 52, Pl. 8, figs. 2-2a). As indicated by Elias (1933) that specimen is not a representative of the genus **Rhaeboceras**. It could indeed be included in **J. plenus** (Meek), although it does not show the incipient multituberculate ribbing of that species, and appears also to be more evolute. Thus, it has some resemblance to the material described herein. Ribbing, however, is sparser and stronger, lateral nodes seem to appear at a later growth stage and the whorl section becomes depressed somewhat earlier.

Dimensions (in mm):

	L	D	U	h	w	l
1. Holotype, AMNH 24234	114	75	?.9(0.11)	46.6(0.62)	60.0(0.80)	31
2. "S. duplicocostatus", holotype, AMNH 24235	-	55.9	68.0(0.12)	32.0(0.57)	42.5(0.76)	-
3. GSC 67096	95.8	63	-	35.7(0.57)	-	22.7
	-	51	6.0(0.12)	29.4(0.58)	35.5(0.70)	-
4. GSC 67095	118	78	8.0(0.10)	46.0(0.59)	62.0(0.79)	34
	-	49.7	6.3(0.13)	30.0(0.60)	37.0(0.74)	-
	-	33	5.2(0.16)	19.3(0.58)	23.6(0.72)	-
5. GSC 5339a "S. subglobosus"	-	51.6	7.2(0.14)	27.3(0.53)	34.4(0.67)	-

	l/L	H	W	w/h	W/H	A	P	S	In	Ex
1. AMNH 24234 holotype	0.27	45.3	51.7	1.29	1.14	117	-	160	17	25-26
2. AMNH 24235 holotype	-	-	-	1.33	-	-	-	-	-	-
3. GSC 67096	0.24	41	45.8	-	1.12	118	-	-	14	-
	-	-	-	1.21	-	-	20	58	10	+16
4. GSC 67095	0.29	-	-	1.35	-	-	-	-	-	-
	-	-	-	1.23	-	-	19	-	-	-
	-	-	-	1.22	-	-	-	-	-	-
5. GSC 5339a	-	-	-	1.26	-	-	18	+64	-	-

Jeletzkytes cf. **brevis** (Meek, 1876) ♀

Plate 5, figures 3-9; plate 6, figures 5-9
Text-figures 14-19, 24b

?1859 **Scaphites nodosus**? var., Meek, p. 185, Pl. 2, figs. 7-8.
?1876 **Scaphites nodosus** var. **brevis**, Meek, p. 426, Pl. 25, figs. 1a-c.
1880 **Scaphites nodosus**, Whitfield, p. 441, pl. 13, fig. 12.
1880 **Scaphites nodosus** var. **brevis**, Whitfield, p. 443, Pl. 13, figs. 8-9.
?1898 **Scaphites nodosus** var. **brevis**, Meek, Logan, p. 511, Pl. CVIII, fig. 3 (Meek's Pl. 25, fig. 1b redrawn).
?1899 **Scaphites nodosus**, Logan, pl. XXII, fig. 2; Pl. XXIII, figs. 1-4, 6-12.
?1905 **Scaphites nodosus** var. **brevis**, Smith, p. 640, fig. 1 (2, 4-7, 9-18), 3 (1-3, 5-6, 8).
1915 **Scaphites binodosus** F.A. Roemer var. **brevis** Meek, Frech, p. 560, fig. 7.
1933 **Acanthoscaphites nodosus** var. **brevis** Meek, Elias, p. 321, Pl. XXXVII, fig. 2, Pl. XLI, fig. 3.
1941 **Scaphites brevis** Meek, Stephenson, p. 426, Pl. 90, figs. 7-8.
1970 **Scaphites brevis** Meek, Jeletzky, Pl. XXVII, figs. 9a-b.
?1977 **Hoploscaphites nodosus brevis** (Meek and Hayden), Kauffman, Pl. 32, fig. 9 (holotype refigured).

Material: One complete but crushed specimen (GSC 21852), from (?)Frenchman River, Saskatchewan (Coll. P.S. Warren, 1928; GSC loc. 97993); one fragmentary specimen with part of the phragmocone and body chamber GSC 67097, and two complete phragmocones with beginning of body chamber GSC 67098 from Belanger Member, Cypress Hills, NE Sec. 16, Tp. 3, Rge. 25, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10407); one complete specimen from Belanger Member, Notukeu Creek, east of Ponteix, Sec. 28, Tp. 9, Rge. 11, W3rd (Coll. P.S. Warren; U.A. 1199); one incomplete and distorted specimen from Southern Albera (Coll. P.S. Warren, 1928; U.A. 510); one (+ ?1) almost complete but crushed specimen GSC 67099 and two crushed phragmocones from ? Swift Current Creek, NE Sec. 35, Tp. 13, Rge. 15, W3rd, Saskatchewan (Coll. P.S. Warren; GSC loc. 97994).

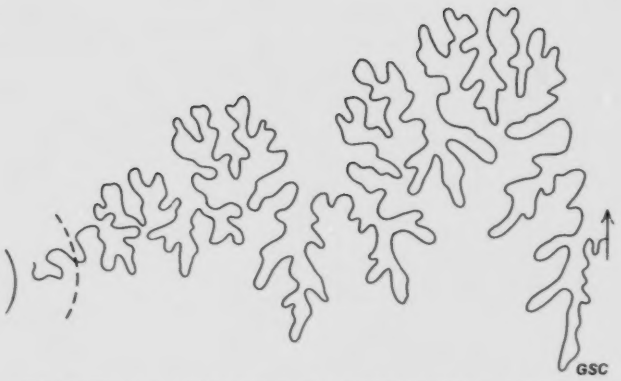
Description: The phragmocone is rather involute between 25 and 35 mm of diameter, with umbilical width amounting to 14-19% of the diameter. The whorl section varies from rounded to depressed (w/h = 0.97-1.28) and the umbilical wall, which is almost vertical, passes transitionally into strongly to slightly curved flanks. The venter is rounded.

Ribs seem to be relatively thicker and blunter on the globose specimens and finer and sharper on the compressed ones. On the flanks they are prorsiradiate and slightly flexuous. On the ventrolateral shoulder they bear small tubercles from which they bifurcate. One or two secondaries become intercalated in the upper part of the flank. All ribs cross the venter forming a shallow apically concave arch.

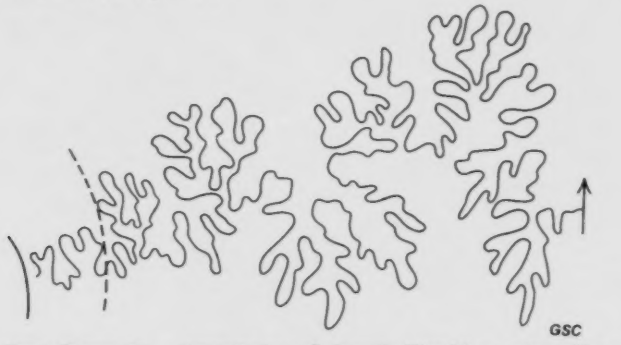
The last whorl of the phragmocone, between c. 40-50 mm of diameter becomes more involute (U/D = 0.07-0.10) and compressed (w/h = 0.88-1.09) in all available specimens. Height is usually slightly larger than width, the umbilical wall is quite steep and the flanks are almost parallel, although still weakly convex, with the maximum width in the lower third. The venter tends to become flat, a feature enhanced by the ventrolateral tubercles and, in some cases, by secondary compression (see GSC 67099; Pl. 5, figs. 8-9). Ribs are relatively sharper and more prorsiradiate and flexuous on the last whorl as compared with the previous whorls. Secondaries originate at different heights on the upper two thirds of the flanks, from ill defined branching points. At the same time primary ribs become thicker on the lower third of the flank, and small nodes are formed. The ventrolateral tubercles become more conspicuous.

Length of mature specimens ranges between c. 77 to 89 mm. The body chamber is deflected and extends slightly beyond the phragmocone. The last suture forms an angle of c. 145° with the axis of the shaft, whose length amounts to 25-30% of the complete shell. Height and width of the body chamber increase from the end of the phragmocone to the middle of the shaft where they reach a maximum. These two dimensions decrease steadily from this swelling towards the aperture. The apertural angle ranges between 110° and 127°.

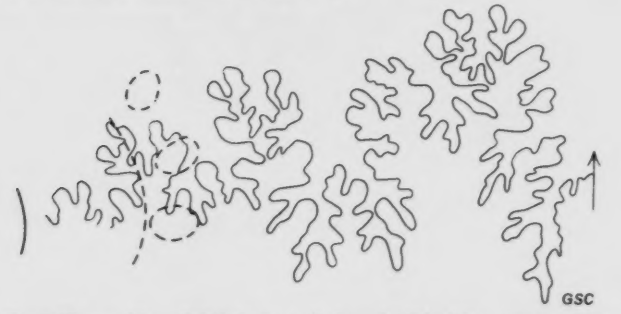
Ribs are usually fine and sharp, when the shell is preserved, but are blunter and sparser on the internal mould. On the shaft they curve backwards on the umbilical wall, and then forwards on the flanks. They divide on the lower third of the flanks, sometimes in coincidence with relatively small nodes. Secondaries also become intercalated on the upper part of the flanks, and all ribs, which count about 130 on the last whorl, cross the venter with a weak forward convex bend. The row of lateral nodes becomes discontinuous on the living chamber where only 2-3 small bullae-like nodes are present. The ventrolateral tubercles increase in size and form clavi towards the middle of the shaft, from where they become smaller towards the aperture.



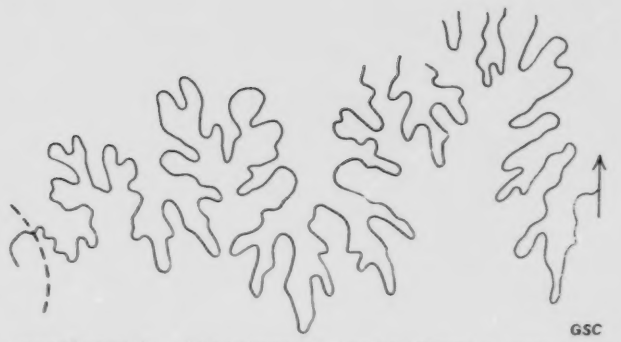
Text-figure 14. ***Jeletzkytes*** *cf.* ***brevis*** *(Meek)* ♀, *suture line of specimen GSC no. 21852, at H = 18 mm and W = 17 mm (see Plate 5, fig. 5-7).*



Text-figure 15. ***Jeletzkytes*** *cf.* ***brevis*** *(Meek)* ♀, *suture line of specimen GSC no. 67098, at H = c. 20 mm and W = 18.4 mm (see Plate 6, fig. 8-9).*

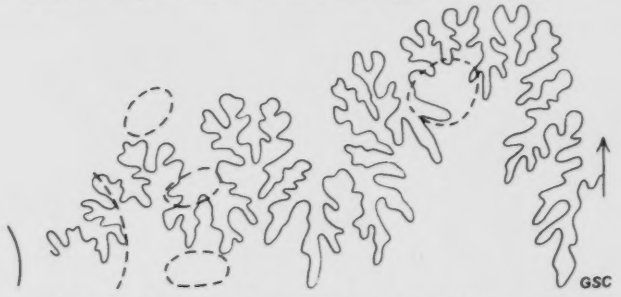


Text-figure 16. ***Jeletzkytes*** *cf.* ***brevis*** *(Meek)* ♀, *suture line of specimen GSC loc. 10407/6, at H = 26.4 mm and W = 29.6 mm.*



Text-figure 17. ***Jeletzkytes*** *cf.* ***brevis*** *(Meek)* ♀, *suture line of specimen GSC no. 67097, at H = 13.5 mm and W = 10.9 mm (see Plate 6, fig. 5-7).*

Text-figure 18. ***Jeletzkytes*** *cf.* ***brevis*** *(Meek)* ♀, *suture line of specimen UA 510, at H = 22.5 mm and W = 31.4 mm.*



Text-figure 19. ***Jeletzkytes*** *cf.* ***brevis*** *(Meek)* ♀, *suture line of specimen UA 1199, at H = 24.2 mm and W = 24.6 mm (see Plate 5, fig. 3-4).*

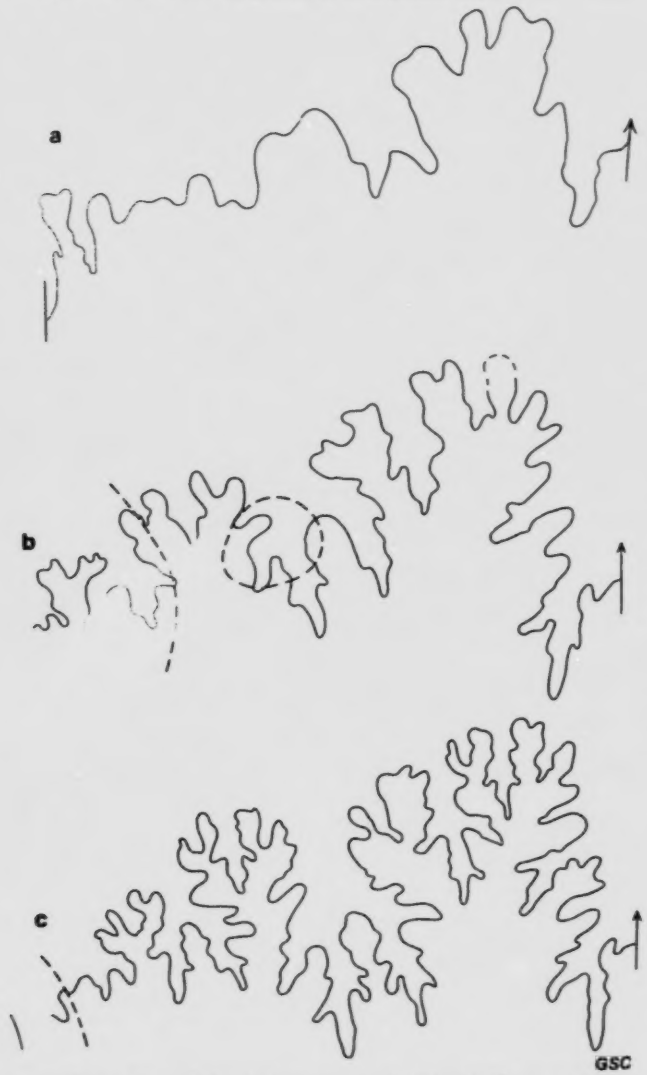
The suture (text-figs. 14-19) is complex. The lateral lobe is asymmetrically bifid and as deep as the ventral lobe. The first lateral saddle is divided into two main branches, with the ventral one being larger than the dorsal. The second lateral saddle is deeply incised, very narrow and divided into 3 marginal branches. The second lateral lobe is much shorter and narrower than the first lateral, whereas the first auxiliary, that is situated almost on the umbilical shoulder, is trifid, less incised and slightly oblique. A second very simple auxiliary lobe is located near but not quite at the umbilical wall of the specimen reproduced in Text-figure 14. However, one can count 3 auxiliaries in the specimen reproduced in Text-figure 15. The auxiliary saddles exhibit a steady decrease in size and complexity towards the umbilical seam. Judging by the suture line of **J. cf. crassus** reproduced in Text-figure 12, the external sutures of **J. cf. brevis** appear to have a considerably lesser number of auxiliary lobes. The taxonomic significance of this possible distinction cannot be evaluated at present, particularly since the complete, internal and external, sutures of both species are not available.

Comments: As is the case with the other species of this group, **J. brevis** (Meek) is a poorly known species. Besides the type (see Pl. 5, fig. 1-2), there are few other specimens in the literature that could be assigned to it.

The first figured specimen probably belonging to this species is that from the south branch of the Saskatchewan River tentatively considered by Meek (1859, Pl. 2, figs. 7-8) as a variety of **J. nodosus** (Owen). The specimen, however, is lost and from what can be seen in the original drawing it seems to lack the coarse ribbing and lateral nodes of this last species. In the finer ribbing and fading of the lateral nodes, as well as in the compression, it resembles **J. brevis** ♀.

Under "**Sc. nodosus** s. str." Whitfield (1880) figured one specimen which appears to be intermediate between **J. brevis** and **J. plenus** (Whitfield, 1880, Pl. XIII, fig. 12, USNM 12284), and was said to be associated with typical **J. brevis**. In fact, this specimen is very close to **J. brevis** in thickness of the whorl, number of secondaries, prominence and distance to the umbilical margin of the lateral row of nodes. It differs in the slightly more rounded flanks and more numerous and conspicuous inner row of nodes, a feature in which it resembles **J. quadrangularis**.

Some resemblance to the type of **J. brevis** are exhibited by the specimen figured in a drawing by Logan (1899, Pl. XXII, fig. 2) and also referred to **J. nodosus**. The drawing, however, is too poor to arrive at a definite conclusion about the taxonomic status of this specimen. Furthermore, under the catalogue number 3653, quoted by Logan (1899, p. 210) the Field Museum collections only have two specimens of larger size and with all features of **J. plenus** (Meek).



Text-figure 20. ***Jeletzkytes cf. brevis (Meek) ♂, suture line of specimen GSC no. 69593 at:***

a) H = 2.4 mm and W = 3.9 mm;
b) H = 5.4 mm and W = 6.9 mm
c) H = 18 mm and W = 11.7 mm.

Material figured by Smith (1905) only includes inner whorls and, therefore, cannot be identified with any certainty.

Perhaps the second best figured specimen, is that of Frech (1915, p. 560, fig. 7) included in "**Scaphites binodosus brevis** Meek". This specimen, which is said again to come from Bad Lands, Dakota, has a larger size, and seems to be more globose, and with a smaller apertural angle than Meek's type. The subspecific relationship of this specimen, and of the species, with **S. binodosus** Roemer (1841, p. 90, Pl. XII, fig. 6) proposed by Frech (1915) has already been rejected by Nowak (1916). This worker pointed out to the strong ribbing change characteristic of this last species, that occurs from the phragmocone to the body chamber and from the flanks to the venter of the body chamber. He correctly argued that the phragmocone of **S. binodosus** has fine radial ribs which on the ventrolateral shoulder bear small nodes from where two ribs are born to cross the venter. The body chamber, instead, has two rows of nodes, one with seven nodes is close to the umbilical margin, while the other with 13 to 16 nodes is on the ventrolateral shoulder. Both rows of nodes are linked by wide bullae-like ribs, whereas on the ventral area there are more numerous and finer ribs.

As pointed out by Nowak (1916) these features are not present in **J. nodosus** and its allies, including **J. brevis** and **J. quadrangularis**. He also pointed out, quite correctly, that **S. inflatus** Roemer (1841, Pl. XIV, fig. 3), a species that Frech (1915) also thought to be similar to **J. brevis** and the probable macroconch of **S. binodosus** (see Schmid and Ernst, 1975, p. 321) differs from it on similar grounds.

The material illustrated by Elias (1933, Pl. XLI, fig. 3; Pl. XXXVII, fig. 2) under "**S. brevis**", although it seems to have been correctly identified, is too poor to add to the knowledge of the species.

The only specimen from Canada so far ascribed to **J. brevis** is that figured by Jeletzky (1970, Pl. XXVII, figs. 9a-b). Again, not only is that specimen more globose, but also appears to have less numerous ribs and ventrolateral tubercles than the type. Furthermore, the ventrolateral tubercles are already present at an earlier growth stage.

On the basis of the literature data and the collection available to the author, including several specimens that seem to come from a single stratigraphic level at ?Swift Current Creek, it appears that **J. brevis** varies in compression and ornament. Compressed specimens, like the type, are densely ribbed and have the ventrolateral tubercles mostly restricted to the end of the phragmocone and the body chamber (GSC 67097, Plate 6, figs. 5-7). Less compressed individuals have fewer ribs and ventrolateral tubercles, which appear at earlier stages of the phragmocone (GSC 67098; Pl. 6, figs. 8-9). One specimen, that seems to be an extreme globose variant transitional to **J. plenus** has a third row of nodes on the upper third of the flank.

As the actual morphological range of the species has yet to be clarified on the basis of the figured specimen and more numerous and stratigraphically better controlled topotype material, the specimens here described and figured are left under open nomenclature.

J. brevis was introduced by Meek (1876, p. 426) as a variety of **J. nodosus** (Owen). In that author's opinion it differed from the latter in having a shorter shaft and hook, more compressed inner whorls and smaller tubercles near the umbilicus. Later Whitfield (1880, p. 443) also pointed to the finer ribbing and the fact that in **J. brevis** the inner row of nodes is rather obscure and restricted to the body chamber, although he considered that the most important differences were to be found in the compressed form and narrower venter of this species.

In fact, and as far as it is shown by the type and the material here described, **J. brevis** differs from **J. nodosus** in being more compressed, having a definite umbilical swelling, more numerous and finer ribs, as well as more numerous, smaller and earlier appearing ventrolateral tubercles. It also has fewer, smaller and internally located lateral tubercles, and the suture line seems to be slightly more incised and with a narrower first lateral saddle.

Dimensions (in mm):

	L	D	U	h	w
1. holotype USNM 367	77.9	47.5	3.9(0.08)	27.8(0.59)	24.4(0.51)
2. GSC 21852	77.1	48	3.5(0.07)	26.0(0.34)	23.9(0.30)
3. U.A. 1199	82.7	50.8	4.4(0.09)	30.1(0.59)	30.0(0.59)
4. U.A. 510	88.4	51.6	5.0(0.10)	31.5(0.61)	34.4(0.67)
5. GSC 67099	79.8	51.6	4.2(0.08)	30.4(0.59)	26.6(0.52)
6. GSC 67098	-	47	4.6(0.10)	27.0(0.57)	28.5(0.61)
	-	32	4.5(0.14)	18.6(0.58)	18.0(0.56)

	l	l/L	H	W	w/h	W/H	A	P	S	In	Ex
1. USNM 367	18.7	0.24	32.7	30.8	0.88	0.94	125	?20	151	4	20
2. GSC 21852	23	0.30	30	30	0.92	1.00	127	-	+122	4	+15
3. U.A. 1199	20.7	0.25	33.2	36.6	1	1.10	110	-	130	10	21
4. U.A. 510	22.2	0.25	-	-	1.09	-	125	-	-	11	-
5. GSC 67099	21.8	0.27	30.2	25.7	0.88	0.85	115	-	-	0.6	23
6. GSC 67098	-	-	-	-	1.06	-	-	15	62	-	15
	-	-	-	-	0.97	-	-	-	-	-	-

Jeletzkytes cf. brevis (Meek, 1876) ♂

Plate 10, figs. 1-21;
Text-figures 20-22

?1860 **Scaphites nodosus** var. **quadrangularis**, Meek and Hayden, p. 420.
?1860 **Scaphites nodosus** var. **exiles**, Meek and Hayden, p. 420.
?1876 **Scaphites nodosus** var. **quadrangularis**, Meek, p. 428, Pl. 25, figs. 2a-c, 4 (non ? Pl. 25, fig. 3a-c).
?1880 **Scaphites nodosus** var. **quadrangularis**, Whitfield, p. 443, Pl. 13, figs. 10-11.
?1905 **Scaphites nodosus** var. **quadrangularis**, Smith, fig. 1 (3), 2 (1).
?1915 **Scaphites binodosus** F.A. Roemer var. **quadrangularis** Meek, Frech, p. 559, fig. 5.
?1931 **Acanthoscaphites nodosus** var. **quadrangularis** (M. and H.), Warren, Pl. I, fig. 2.
?1933 **Acanthoscaphites nodosus** var. **quadrangularis** Meek and Hayden, Elias, p. 322, Pl. XXXVII, fig. 3.
1952 **Scaphites (Scaphites) elegans** Tate, Jeletzky, in Cobban and Reeside, p. 1027 (non Tate, 1865).
1968 **Scaphites elegans** Tate, Jeletzky, p. 49 (non Tate, 1865).
?1977 **Hoploscaphites nodosus quadrangularis** (Meek and Hayden), Kauffman, Pl. 32, fig. 8 (paratype refigured).

Material. Five incomplete body chambers, four of them with part of the inner phragmocone whorls (GSC 67100-67103-69593), ?one inner phragmocone whorl and two crushed fragments, from Belanger Member, Cypress Hill, NE Sec. 16, Tp. 3, Rge. 25, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10407); one almost complete body chamber and two fragments of phragmocone whorls from Belanger Member, north side of Cypress Lake, Sec. 14, Tp. 6, Rge. 27, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10395); one complete specimen from near Ponteix, Saskatchewan (Coll. P.S. Warren; U.A. 03943 (Ct. 1).

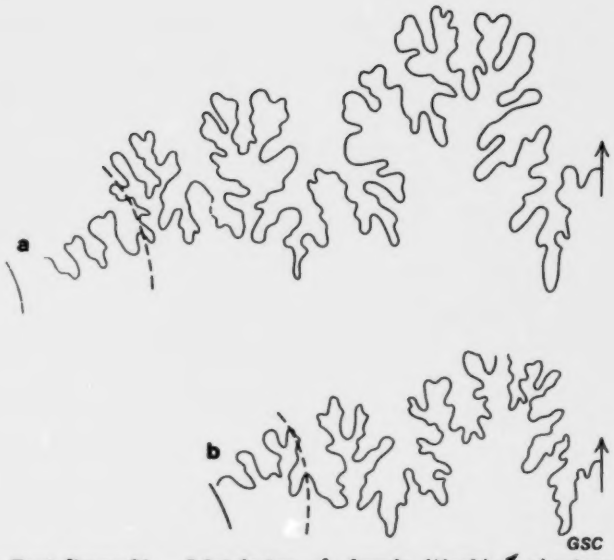
Description: The innermost whorls, at about 10 mm diameter, are depressed and elliptical to subcircular in cross section. With the following whorl and up to c. 30 mm, the whorl section becomes subquadratic to subrectangular (w/h = 0.88-1.09), with almost parallel flanks, subvertical umbilical wall and rounded venter. Coiling is quite involute, the umbilical width ranging from about 14 to 18% of the diameter. The ornament consists of about 10-23 ribs that cross the umbilical wall with a backward projection to become weakly to strongly projected, and somewhat flexuous on the flanks. Ribs are rounded and as wide as the interspaces near the umbilical margin but become more widely separated towards the upper part of the flanks, where secondaries become intercalated at different heights. Primaries are usually stronger, especially in the more inflated whorls, and commonly bear small nodes on the ventrolateral shoulder from which two secondaries are born. One specimen (GSC 67102, Pl. 10, figs. 19-21) exhibits 2-3 very weak node-like thickenings of the ribs in the upper part of the flank. All secondaries cross the venter, where they number 40-50 per whorl, with equal strength and forming a shallow adapical concavity.

At the end of the phragmocone, c. 30 to 35 mm in diameter, the ventrolateral nodes become larger and small nodes may begin to develop near the umbilical margin of the more inflated specimens.

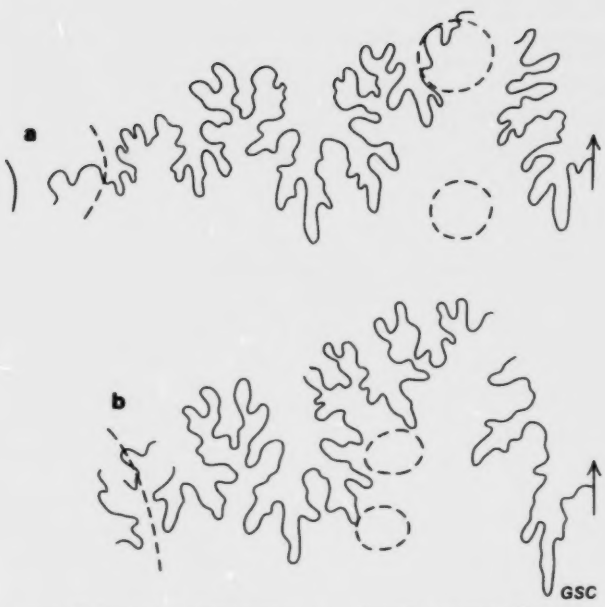
Total length of adult specimens ranges between c. 55 to 68 mm, the most common values being closer to 60 mm. The body chamber is deflected, extending slightly beyond the phragmocone. Its inner margin forms an open curve without swelling. The shaft amounts to 26 to 29% of the total length of the shell. Whorl section is subquadratic (W/H = 0.85-1.22) and width and height increase steadily throughout the body chamber to reach their maximum values just before the weakly contracted aperture. The apertural angle ranges from 110 to 125°.

Ribs are relatively fine and sharp. Where visible, they cross the vertical umbilical wall with a backward projection to bend forward on the umbilical margin where 3 of every 5 merge to form either small sharp nodes or less visible bullae. Bundles of 3 to 5 ribs arise from each umbilical node or bulla, between which 1 or 2 independent ribs are intercalated. In the most compressed, and usually larger, specimens ribbing is denser and most primaries are irregularly divided near the middle of the flanks. With growth, the ventrolateral tubercles increase in size to form clavi in the middle of the shaft. From there onwards they become smaller to disappear at variable distances before the aperture. Two to four lateral and four to six ventral ribs merge in each ventrolateral tubercle. As has already been mentioned, the ornament seems to vary with the whorl section. Thus, the most compressed specimens are characterized by finer and denser ribbing and inconspicuous umbilical bullae, while the most depressed ones have sparser and sharper ribs and umbilical nodes. It also seems that in these last specimens the ventrolateral tubercles extend farther adorally into the proximity of the aperture.

The suture is complex (text-fig. 21-22). The lateral lobe is asymmetrically bifid and as deep as the ventral lobe. The first lateral saddle is rather wide and divided into two main branches, with the ventral branch being larger than the dorsal. The second lateral saddle is deeply incised, very narrow and divided into three unequal branches. The second lateral lobe is much shorter and narrower than the first. The first auxiliary lobe, that is almost on the umbilical shoulder,



*Text-figure 21. **Jeletzkytes** cf. **brevis** (Meek) ♂. a) suture line of specimen GSC no. 67102, at H = 9.4 mm and W = 10.2 mm (see Plate 10, fig. 19-21); b) suture line of specimen GSC no. 67101, at H = 7.5 mm and W = 7.2 mm (see Plate 10, fig. 10-14).*



*Text-figure 22. **Jeletzkytes** cf. **brevis** (Meek) ♂. a) suture line of specimen UA 03943, at H = 20.6 mm and W = 16.6 mm; b) suture line of specimen GSC no. 67103, at H = 13.3 mm and W = 14.6 mm (see Plate 10, fig. 15-16).*

is much simpler and oblique. A second very simple auxiliary lobe is located on the umbilical wall. There appears to be enough room for the third auxiliary lobe between the second auxiliary and the umbilical seam in the suture reproduced in Figure 21a, but not in that reproduced in Text-figure 21b. Sutures reproduced in Text-figure 22a and b are similar to others but too incomplete to be evaluated definitively. The auxiliary saddles steadily decrease in size towards the umbilical seam.

Comments: Under "**Scaphites nodosus** var. **quadrangularis**", Meek (1876, Pl. 25, figs. 2,3,4) figured 3 rather different specimens, which were said to come from the same stratigraphic level as **J. brevis**. They were said to differ from the latter in the smaller size, flattened periphery, larger umbilicus and more adumbilically located inner row of nodes.

In fact, the paratype figured by Meek (1876) on Plate 25, figs. 2a-c (here refigured on Pl. 10, fig. 3-4), as well as the specimen illustrated by Whitfield (1880, Pl. 13, figs. 10-11), bear a strong resemblance to **J. brevis**, despite the smaller size, more curved inner margin, more internally located inner row of nodes and lack of ventrolateral tubercles on the hook. The holotype (Meek, 1876, Pl. 25, figs. 3a-c; here refigured on Pl. 10, figs. 5-6), however, though similar in size to the previously mentioned paratype, has a subquadratic whorl section and a less dense and flexuous ribbing. Similar differences are exhibited by the other paratype (Meek, 1876, Pl. 25, fig. 4; here refigured on Pl. 10, figs. 1-2), which is also larger, has more prominent nodes and ventrolateral tubercles extending closer to the aperture.

Of the other figured material, that of Smith (1905, fig. 1-3, fig. 2-1) and Elias (1933, Pl. XXXVII, fig. 3) do not add to the understanding of the type material, while the specimen near Glendive, Montana, figured by Frech (1915, fig. 5) is similar to the holotype.

Different features of these specimens, such as the small size, curved inner margin of the body chamber and open umbilicus, fit with those usually ascribed to the microconchs of the scaphitids (see Cobban, 1969; Crick, 1978; Jeletzky and Waage, 1978). Similarly, the stratigraphically associated **J. brevis** (Meek) has all the features usually found in the macroconchs of this group. Thus, as previously indicated by Cobban (1969, p. 8) these two varieties of Meek (1876) seem to correspond to a single dimorphic pair, which should be included under a single name.

Most of the material available to the author comes from a single stratigraphic level of the Belanger Member of the Bearpaw Formation (GSC loc. 10407), and exhibits similar features to those present in the less compressed specimens of **J. quadrangularis** known from the literature. They also show similarities to other microconchs here included in **J. criptonodosus** sp. nov., although these last seem to be even smaller and more evolute. The specimens here described, however, are associated with a fragment of macroconch showing more features in common with **J. brevis** than with **J. criptonodosus** sp. nov.

Given the poor preservation of the actually associated macroconchs and the close similarities usually shown by the microconchs of different species, it cannot be excluded that this material belongs to an hitherto unnamed species closely related to **J. brevis**. It seems advisable, therefore, to leave this material under open nomenclature.

A close relationship of these microconchs with **S. binodosus** Roemer, previously suggested by Frech (1915), has already been rejected by Nowak (1916) and is discussed at length under **J.** cf. **brevis** ♀.

The idea of a close affinity of **J. quadrangularis** with European species was reviewed by Jeletzky (in Cobban and Reeside, 1952; and 1968) on the basis of the material here described. He regarded the **J. nodosus** group to be an equivalent of the "**H. roemeri** group" of Europe, and considered that **S. elegans** Tate (1865) was an extreme variant of "**S. roemeri** s.l." very close to "**S. roemeri** var. **tuberculata**"

as figured by Mikhailov (1951, Pl. XVI, figs. 74-75). This last was thought to be (see Jeletzky, 1968, p. 49, 50) almost indistinguishable from some variants of **J. quadrangularis.**

The plaster cast of the holotype of **S. elegans** Tate (1865, p. 37, Pl. III, fig. 3) as well as that of its topotype have been examined and the first is here figured for comparison (Plate 10, figs. 22-23). They come from the White Limestone (Antrim Beds) of northern Ireland, where **Belemnitella mucronata** is abundant.

S. elegans appears to be characterized by the subquadrate whorl section, almost flat flanks and slightly rounded venter; two rows of similarly sized tubercles are developed near the umbilical margin and on the ventrolateral shoulder; ribs are fine and sharp and cross the flanks with a forward projection.

Even if it is true that the two available specimens exhibit similarities with some of the Western Interior specimens (see Pl. 10, figs. 17-18), there are several differences of probable taxonomic significance. Thus, **S. elegans** seems to have a more depressed and rounded whorl section, its umbilical wall is less steep and the ribs are more steadily projected forward and less flexuous than in **J. cf. brevis** ♂. In the latter microconch the umbilical tubercles are smaller than the ventrolateral ones while the last develop into clavi in the middle of the shaft and do not reach the aperture. In **S. elegans** the tubercles of both, the lateral and ventrolateral rows, are similar in size and the last extend until the end of the body chamber. Furthermore, in **J. cf. brevis** ♂ the end of the curved inner margin of the body chamber is almost coincident with the end of the shaft, whereas in **S. elegans** the inner margin of the shaft passes to the strongly curved inner margin of the hook, in such a way that the aperture, which has an angle of c. 90°, is completely separated from the shaft.

Despite the fact that the range of morphological variation of **S. elegans** is unknown, it seems that all these differences are important enough to maintain these European and North American specimens under different specific names. **S. elegans** in fact could be a junior subjective synonym of **S. tuberculatus** Giebel, a possibility hinted at by Blaszkiewicz (1980, p. 38; see Pl. 19, fig. 1,4). **"S. quadrangularis"** has also been reported from the Upper Campanian of East Greenland (see Donovan, 1953, p. 124; Pl. 24, fig. 8), but it must be agreed with Birkelund (1965, p. 167) that, in spite of some resemblances, the Greenland specimen cannot be identified with any degree of reliability.

Dimensions (in mm):

	L	D	U	h	w	l
1. GSC 67100	60	-	-	-	-	-
2. GSC 67101	56	22.4	4.2(0.18)	11.9(0.51)	10.6(0.47)	15.5
3. GSC 67102	50.3	30.2	4.4(0.14)	17.3(0.57)	16.1(0.53)	14.7
4. GSC 67103	58	24.3	-	12.4(0.51)	12.4(0.51)	-
5. UA. 03943	59.7	36.6	3.9(0.10)	20.7(0.56)	16.7(0.45)	15.5

	l/L	H	W	w/h	W/H	A	P	S	In	Ex
1. GSC 67100	-	24.1	23.3	-	0.96	?115	-	80	3	4
2. GSC 67101	0.27	25	21.3	0.88	0.85	-	23	+40	5	7
3. GSC 67102	0.29	-	-	0.93	-	-	c.14	50	-	-
4. GSC 67103	-	21	25.6	1	1.22	-	-	-	-	-
5. UA. 03943	0.26	22.4	24.5	0.80	0.94	c.120	-	121	2	16

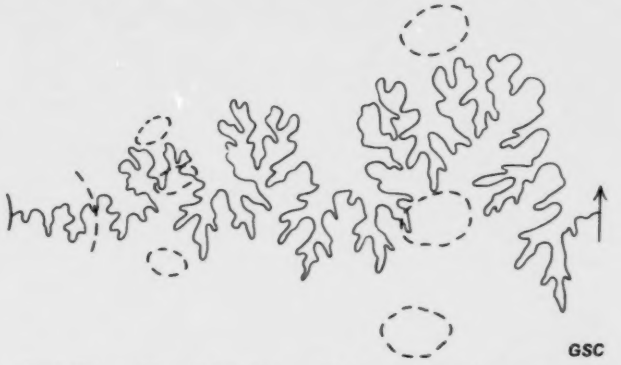
Jeletzkytes aff. brevis (Meek, 1876) ♀

Plate 6, figures 1-4; Text-figures 23, 24c

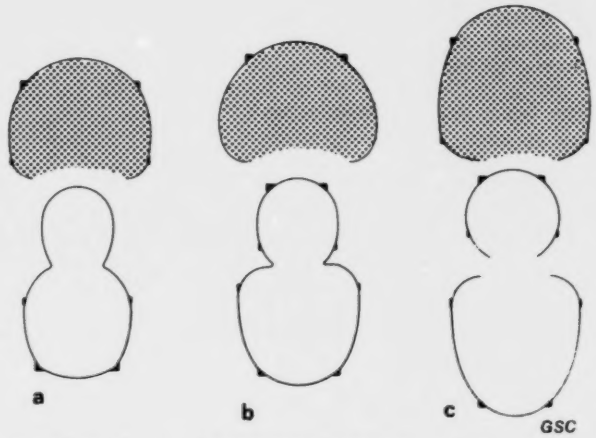
Material: One almost complete specimen (GSC no. 5368) from Dirt Hills, South of Regina, Saskatchewan (Coll. A. Mowat, 1892; GSC loc. 97995).

Description: The phragmocone becomes progressively more involute between 15 and 40 mm of diameter, with umbilical width amounting to 15-18% of the diameter. The whorl section is slightly depressed, although it becomes almost subquadrate (w/h = 1.26-1.10) as growth proceeds. The umbilical wall is vertical and passes transitionally into slightly curved flanks. The venter is rounded.

The last whorl of the phragmocone (D = 62.2 mm) becomes more involute (U/D = 0.09) and compressed (w/h = 0.93). Height is larger than width, the umbilical wall is quite steep and the flanks are weakly curved with the maximum width below the middle part of the section. The venter remains rounded although the whorl section becomes more subquadrate due to the prominence of the ventrolateral tubercles. Ribs are rounded, slightly narrower than the interspaces, weakly prorsiradiate and flexuous. Almost all primaries bear nodes in the middle of the lower third of the



Text-figure 23. *Jeletzkytes aff. brevis (Meek), ♀ suture line of specimen GSC no. 5368, at H = 27.5 mm and W = 27.5 mm (see Plate 6, fig. 1-4).*



Text-figure 24. *a) Jeletzkytes brevis (Meek) ♀, cross section of holotype, USNM 367 (Pl. 5, figs. 1, 2); b) Jeletzkytes cf. brevis (Meek) ♀, cross section of specimen UA 1190 (Pl. 5, figs. 3, 4); c) Jeletzkytes aff. brevis (Meek), ♀ cross section of specimen GSC no. 5368 (see Plate 6, fig. 1-4). Body chambers stippled; X0.65.*

flank. Secondary ribs, arise in twos or threes from these tubercles, or become intercalated at different heights of the flanks. Some of these ribs bear tubercles on the ventrolateral margins. At smaller diameters the tubercles are present on each rib or every second one, and later on every third to fourth rib. Two or three ribs are formed from these tubercles on the venter, where all secondaries form a shallow adapically concave bow.

Length of the mature specimen is 98.6 mm. The body chamber is deflected, extending slightly beyond the phragmocone. The last suture forms an angle of c. 150° with the axis of the shaft, whose length amounts to c. 27% of the total shell. Height and width of the body chamber increases towards the middle of the shaft, where a weak swelling is present, to decrease again afterwards. The aperture is incompletely preserved, but the cross-section is almost as high as wide (W/H = 0.97) and the apertural angle is c. 125-130°. Ribs become more rounded, and less prominent. They are prorsiradiate and divide on the lower third of the flanks, usually in coincidence with rather blunt nodes. Secondaries also become intercalated on the flanks and all ribs, c. 90 on the last whorl, cross the venter with a weak forward projection. The ventrolateral tubercles increase in size and form clavi about the middle of the shaft, from where they exhibit a slight decrease towards the aperture.

The suture (text-fig. 23) is complex, with an almost symmetrically bifid lateral lobe, which is as deep as the ventral lobe. The second lateral lobe is asymmetrically bifid and shorter than the first lateral. The first auxiliary is rather simple, asymmetrically bifid and highly oblique. The second, third and fourth auxiliary lobes are simple trifid structures situated on the umbilical wall. The first lateral saddle is divided into two main branches, with the ventral one larger than the dorsal. The second lateral saddle is narrow, deeply incised and divided into three unequal branches.

Comments: This specimen differs from the type of **J. brevis** (Meek) in being less compressed throughout, in developing lateral and ventrolateral tubercles at an earlier stage of the phragmocone, and in the blunter and less numerous ribs and tubercles of the body chamber. In all these features it resembles the material described above under **J. cf. brevis** ♀. This specimen, however, is larger and has fewer and blunter ribs and tubercles in the last whorl, in spite of the rather similar whorl section. This specimen is closer to the other Canadian material of **J. cf. brevis** ♀ than to the type of **J. brevis**. Generally speaking, the suture line of **J. aff. brevis** appears more similar to that of **J. cf. crassus** (text-fig. 12) than to that of **J. brevis** (text-fig. 15) in the apparently greater number of auxiliary lobes.

Dimensions (in mm):

	L	D	U	h	w	l
1. GSC 5368	98.6	62.2	5.6(0.09)	36.7(0.59)	34.0(0.55)	26.8
	-	39.7	6.0(0.15)	20.8(0.52)	22.9(0.58)	-
	-	14.9	2.7(0.18)	7.0(0.47)	8.8(0.59)	-

	I/L	H	W	w/h	W/H	A	P	S	In	Ex
1. GSC 5368	0.27	38.6	37.5	0.93	0.97	125-130°	22	90	10	22
	-	-	-	1.10	-	-	-	-	-	-
	-	-	-	1.26	-	-	-	-	-	-

Jeletzkytes criptonodosus sp. nov. ♀

Plate 6, figure 10; Plate 7, figures 1-2;
Plate 8, figures 7-9; Text-figures 25-27

Holotype: The complete specimen (GSC 67104) figured on Plate 6, figure 10, Plate 7, figures 1-2, Belanger Member, north side of Frenchman River, just west of road from Caton's ranch to Robsart, Sec. 14, Tp. 6, Rge. 25, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10374).

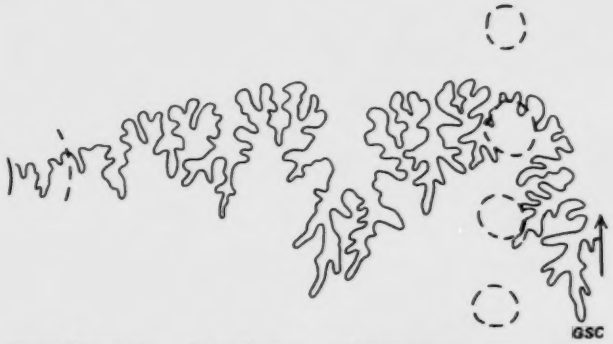
Derivation of name: Derived from the rather obscure multituberculate phragmocone.

Diagnosis: Medium-sized species of **Jeletzkytes**, with body chamber extending slightly beyond the phragmocone; phragmocone involute, whorl section varying from slightly depressed to slightly compressed throughout the ontogeny; apertural angle c. 132°-140°. Ribbing relatively sparser and more weakly prorsiradiate on the phragmocone than on the body chamber, with ventrolateral tubercles throughout. This growth stage is also characterized by the presence of a row of lateral nodes on the upper part of the flanks, and by an incipiently multinodose appearance of the ribs. Body chamber with ventrolateral tubercles and dense, fine and sharp ribbing. Suture complex, with asymmetrically bifid lateral lobe shorter than the ventral lobe.

Material: The holotype GSC 67104; one incomplete specimen (GSC 67105) from the same locality as the holotype; and ?one incomplete specimen GSC 69616, from Belanger Member, Battle Creek, Sec. 10, Tp. 7, Rge. 29, W3rd, Saskatchewan (Coll. G.M. Furnival, 1941; GSC loc. 16325).

Description: Between 12 and 22 mm of diameter the phragmocone is involute (U/D = 0.16), and globose with a whorl section varying from more to less depressed (w/h = 1.45-1.08). The umbilical wall is vertical and passes with a rounded shoulder into weakly curved to flat flanks, which converge in a broadly rounded venter. Lateral ribs, c. 14 per whorl, are strong and rounded; they are weakly prorsiradiate and flexuous and bear sharp nodes on the ventrolateral shoulder, from which 2 ventral ribs are born. These cross the venter without interruption, the adapertural one forming a weak and forward convex bow. For about a quarter of whorl, between c. 15-20 mm of diameter the lateral ribs thicken above the middle of the flanks forming a row of diminute nodes.

The last whorl of the phragmocone, up to its end at c. 55-60 mm of diameter, becomes more involute (U/D = 0.12-0.08) and compressed (w/h = 0.95-0.87). The whorl section is subtrapezoidal in shape, with vertical umbilical wall, rounded margin and weakly converging and almost flat flanks. The venter is almost tabulate due to the ventrolateral tubercles. Lateral ribs remain weakly prorsiradiate, but become slightly more flexuous, and secondaries are intercalated at different heights. The strength of each rib changes repeatedly and irregularly from the inner to the outer margin of the flank. At some points, especially in the lower and upper third of the flank, they form node-like thickenings. The ventrolateral nodes become progressively stronger and all ribs cross the venter forming a shallow adapical concavity.



***Text-figure 25. Jeletzkytes criptonodosus** sp. nov. ♀, holotype, GSC no. 67104, suture line at H = 34.5 mm and W = 29.7 mm (see Plate 6, fig. 10; Plate 7, fig. 1-2).*

The length of the mature specimens appears to range between 85 and 90 mm. The body chamber is deflected and extends shortly beyond the phragmocone. The last suture forms an angle of c. 140° with the longest axis of the shell. Shaft length amounts to c. 25% of the complete shell. Maximum whorl width and height is at the middle of the body chamber, where a small umbilical swelling occurs. The umbilical wall is vertical and almost straight until the aperture. At the end of the body chamber the whorl section is subrounded with evenly curved flanks and venter, and slightly higher than wide. The apertural angle is 132 to 140°.

Ribs become finer and more densely prosiradiate and flexuous where the shell is preserved, but look blunter and fade on the internal mould. Numerous secondaries are intercalated at different heights. Tubercles are restricted to the ventrolateral shoulder. They increase in size towards the middle of the shaft, from which point they become progressively smaller towards the aperture. There are about 33 tubercles on the last whorl.

The suture is complex. The lateral lobe is asymmetrically bifid and shorter than the ventral lobe. The second lateral lobe is also asymmetrically bifid, but narrower and half as deep as the first. The first auxiliary lobe is slightly oblique and less incised. The second to fourth auxiliary lobes are simple trifid structures located on the umbilical shoulder and wall (text-fig. 25). The first lateral saddle is rather narrow and divided into two main branches, the ventral branch being much larger than the dorsal. The second lateral saddle is narrower and divided into three branches of different sizes. Auxiliary saddles exhibit a steady decrease in size and complexity towards the umbilical seam.

Comments: This species seems to be close to **J. brevis** (Meek). However, it differs from the type of that species in the wider whorl section throughout the ontogeny and the different ornament of the phragmocone. It also has a more complex suture line, with a deeper lateral lobe, narrower and more indented saddles and four auxiliary lobes. This suture is very similar to that of **J. cf. crassus** and **J. aff. brevis** (cf. text-figs. 12, 23, 25). Probably the most distinctive feature of **J. criptonodosus** is the sparser and irregular ribbing and the presence of nodes in the innermost whorls.

In fact, this species appears to be connected with the type of **J. brevis** through the morphologically intermediate material that here has been placed in **J. cf. brevis** (Meek) ♀. That material includes specimens with similar and even larger width of the whorl section, as well as nodose inner whorls. **J. criptonodosus** sp. nov., however, differs in the more incised suture line, with narrower elements, deeper first lateral lobe and four auxiliary lobes. It also differs in the more tabulate venter of the phragmocone. However, the main distinction is the appearance of a second lateral row of nodes on the upper part of the flanks of what seems to be an incipient multituberculate phragmocone.

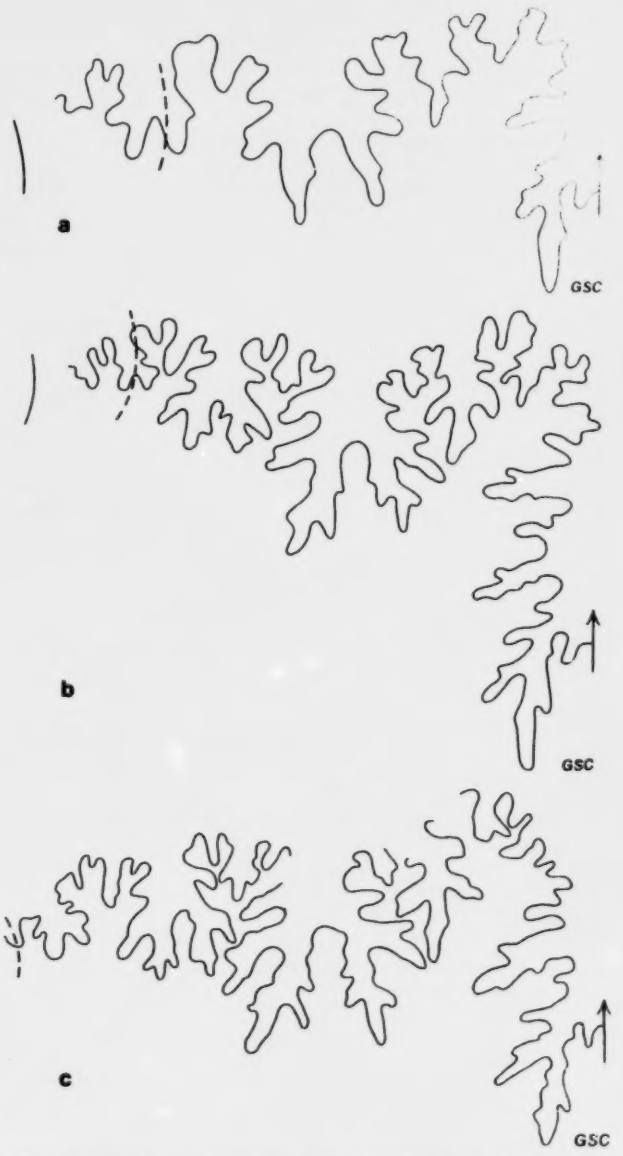
In these last features this species is similar to **J. plenus** (Meek) and to certain Western Interior scaphitids usually included in **Discoscaphites** Meek, e.g. **D. cheyennensis** (Owen) **D. comprimus** (Owen) (including **D. intermedius** Meek). It differs, however, from all these species, in size, globosity and sparser ornament of the phragmocone.

An incomplete specimen from GSC loc. 16325 tentatively included in this species exhibits a similar involution and cross-section, as well as the characteristic incipient multituberculation. However, it has sharper, slightly denser and more flexuous ribs.

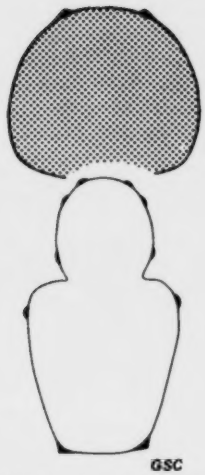
Dimensions (in mm):

	L	D	U	h	w	l
1. GSC 67104	85.5	34.6	4.3(0.08)	33.7(0.63)	30.9(0.57)	21
2. GSC 67105	90	39.3	5.4(0.09)	36.3(0.62)	34.3(0.58)	22.5
	-	38.4	4.6(0.12)	22.0(0.57)	21.0(0.55)	-
	-	22.3	3.6(0.16)	13.9(0.62)	15.0(0.67)	-
	-	12	-	5.3(0.44)	7.7(0.64)	-

	l/L	H	W	w/h	W/H	A	P	S	In	Ex
1. GSC 67104	0.25	33.6	30.9	0.87	0.92	132°	16	-	?3	33
2. GSC 67105	-	-	?34	0.95	-	140°	-	-	-	-
	-	-	-	0.95	-	-	-	-	-	-
	-	-	-	1.08	-	-	14	?35	-	-
	-	-	-	1.45	-	-	-	-	-	-



Text-figure 26. ***Jeletzkytes criptonodosus*** *sp. nov. ♀, suture lines of specimen GSC no. 67105 at: a) H = 5 mm and W = c. 7.4 mm; b) H = 12 mm and W = 15 mm; c) H = 21.9 mm and W = c. 21.5 mm, (see Plate 8, fig. 7-9).*



Text-figure 27. ***Jeletzkytes criptonodosus*** *sp. nov. ♀, cross section of the holotype, GSC no. 67104. Body chamber stippled (see Plate 6, fig. 10; Plate 7, fig. 1-2); X0.78.*

Jeletzkytes cf. criptonodosus sp. nov. ♂

Plate 11, figures 1-21; Text-figures 28-31

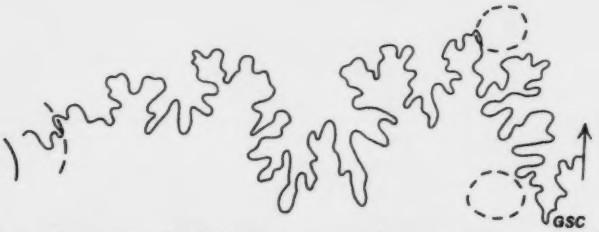
1952 **Scaphites (Hoploscaphites) pungens,** Jeletzky, in Cobban and Reeside, p. 1026 (non Binkhorst, 1861).

Material: One almost complete GSC 61107 and four incomplete specimens (GSC 67107a, b, c, d) from Belanger Member, north side of Frenchman River, just west of road from Caton's ranch to Robsart, Sec. 14, Tp. 6, Rge. 25, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10374); two almost complete specimens (GSC 67106, 67108) from SW of Milestone, SE 1/4, Tp. 10, Rge. 20, W2nd, Saskatchewan (Coll. R. Graham, 1936; GSC loc. 10437); one almost complete specimen (GSC 67109) from West of Dam Coulée, about 1.6 km (1 mi) west of Highway 21, south side of Cypress Lake, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10398); two almost complete and ?3 inner whorls, ?from shaft sunk at Lampman, Saskatchewan (Coll. D.B. Dowling, 1920; GSC loc. 16338) one (+1?) almost complete specimen (GSC 67110) from Ponteix, Saskatchewan (Coll. P.S. Warren, 1930; GSC loc. 16326); ?one complete specimen (GSC 67111) from Belanger Member, from talus 0.40 km (1/4 mi) north of junction of Davis Creek and Frenchman River, 183 m (200 yd) east of cabin (Coll. G.M. Furnival, 1940; GSC loc. 10375); ?one almost complete specimen from Notukeu Creek, near Cadillac, Saskatchewan (Coll. P.S. Warren, 1928; U.A. 752).

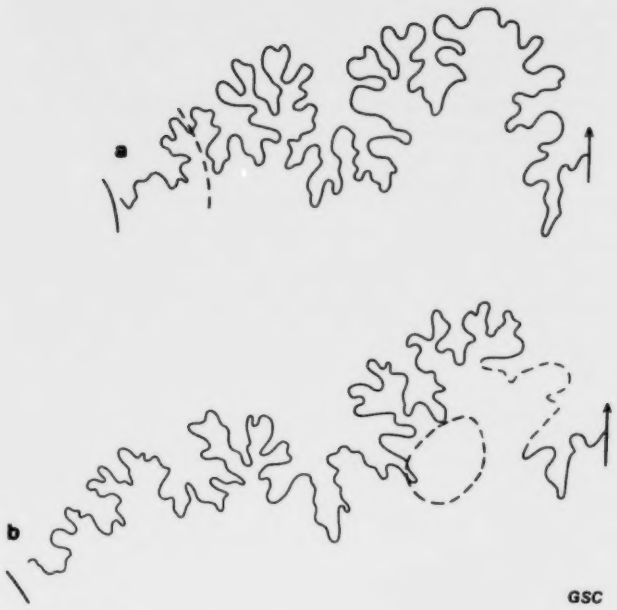
Description: The shell is rather involute (U/D = 0.12-0.20), slightly compressed (w/h = 0.77-0.96), with subrectangular to subrounded whorl section, between 20 and 30 mm, which is the size range of the complete adult phragmocone. The umbilical wall is vertical, the flanks vary between parallel to curved and the venter between flat and rounded. Primary ribs amount to c. 10 per half whorl; at first they are almost straight and separated by interspaces twice as wide, but as growth proceeds they become slightly prorsiradiate, flexuous and closely spaced. These changes are usually accompanied by the appearance of secondary ribs, first in the upper part of the flanks, and later below the middle of the flanks. In the upper part of the flank all primaries bear small but conspicuous tubercles, from each of which two ventral ribs originate. All ribs cross the venter with a very weak adapertural projection. Rib strength exhibits appreciable, changes across the flank. This change in ribs' strength is mostly visible where they bend to produce a flexuous pattern, i.e. in the lower and upper thirds of the flank. The thickening of ribs on the lower part of the flank is accompanied by the appearance of small tubercles near the end of the phragmocone and beginning of the body chamber. Another swelling of the ribs produces inconspicuous nodes on the upper third of the flanks, which are only visible for a very short distance extending approximately over one-half a whorl before the end of the phragmocone.

Total length of adult specimens ranges between 40 and 50 mm. The body chamber is deflected, extending slightly beyond the phragmocone. Its whorl section ranges from compressed subrectangular to depressed subquadrate, with the width increasing steadily towards the aperture, while the height decreases after reaching a maximum at the middle of the body chamber. The apertural angle appears to range between 120 and 140°. Flanks and venter vary from almost flat to weakly curved. On the lower third of the flanks the nodes increase in size developing into 4 to 7 bullae, from which two to four ribs originate. These ribs are prorsiradiate and flexuous. They attain their maximum strength in the middle of the body chamber. Most of them end in 6 to 10 ventrolateral clavi-like tubercles. These are usually connected by 2 to 3 ventral ribs, some of which may connect clavi belonging to different pairs, thus forming a zig-zag pattern. The number of furcations of primaries, and accordingly that of secondaries per primary rib, increases in the last quarter of the body chamber. Ribs become finer and the ventrolateral nodes fade away. In stouter and strongly ribbed specimens the ventrolateral nodes disappear at shorter distances from the aperture than in the more compressed and more finely ribbed specimens. Number of secondary ribs on the last whorl amounts to c. 70-85.

The rather simple suture line (text-figures 28-31) has an asymmetrically bifid first lateral lobe, which is as deep as the ventral lobe. The second lateral lobe is asymmetrically trifid and half as long as the lateral. The first auxiliary is a simple asymmetrically trifid structure, which is oblique. The second and last auxiliary is a simple asymmetrically trifid structure situated on the umbilical wall. The first lateral saddle is relatively wide and divided into two main branches, with the ventral branch larger than the dorsal one. The second lateral saddle is narrower and deeply incised.



Text-figure 28. ***Jeletzkytes cf. criptonodosus*** *sp. nov. ♂, suture line of specimen GSC no. 67111, at H = 14.3 mm and W = 12.7 mm (see Plate 11, fig. 1-3).*

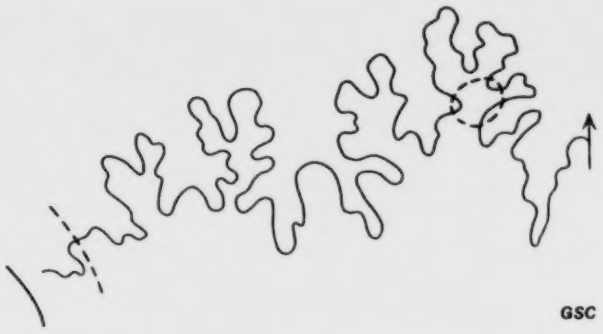


Text-figure 29. Jeletzkytes cf. criptonodosus sp. nov. cf. suture lines of: a) specimen GSC no. 67106, at H = 9.3 mm and W = 7.6 mm (see Plate 11, fig. 12-14); b) specimen GSC no. 67108, at H = 17.6 mm and W = 17.6 mm (see Plate 11, fig. 4-6).

Text-figure 30. Jeletzkytes cf. criptonodosus sp. nov. cf. suture line of specimen GSC no. 67107b, X15, at H = 11.9 mm and W = 9 mm (see Plate 11, fig. 15-16).

Comments: The specimens described herein show a large variation in umbilical width, degree of compression, and strength of ornament. The fact that several of them seem to belong to a single assemblage (GSC loc. 10374) allows, however, to consider much of the above discussed morphologic variation as intraspecific.

Thereafter there is almost no problem in placing within this morphologic range single specimens coming from other localities (GSC loc. 10398; GSC loc. 16338). There are, however, a few remaining specimens, of those available to the author, that show some differences that could have



Text-figure 31. Jeletzkytes cf. criptonodosus sp. nov. cf. suture line of specimen GSC no. 67109 at H = 11.2 mm, and W = 8.9 mm, (see Plate 11, fig. 7-11).

taxonomic significance. Thus, one specimen from GSC loc. 10374 seems to have a relatively more evolute adult phragmocone with sparser and straighter primaries and almost without secondaries. However, this seems only to represent the persistence to a slightly older stage of those features found in the inner whorls of the specimens most commonly represented within this assemblage.

More important is, perhaps, the relatively larger body chamber of specimen GSC 67111 (from GSC loc. 10375) reproduced in Plate 11, figures 1-3, which at its end is more widely separated from the phragmocone than that of any other specimen here described. In that feature this specimen resembles the holotype of **J. quadrangularis** (Meek, 1876, Pl. 25, figs. 3a-b), although it is smaller, more compressed and has a different ornament. However, another specimen that, even if crushed, appears to have a similarly deflected body chamber (GSC 67110, Plate 11, fig. 17; from GSC loc. 16326), is associated with yet another specimen showing all the features found in the largest assemblage here described. Its possible seggregation in another taxon, whose specific independence should be confirmed by a different stratigraphic range, must await the discovery of more abundant material.

Finally, there is a specimen (U.A. 752, Plate 11, figs. 18-21) agreeing with the rest in all features of the body chamber. However, it has a relatively more evolute phragmocone with unusually rounded whorl section and fine ribbing. It also lacks multituberculate ribs. This specimen is only tentatively included in our species.

The above described material has all the features usually ascribed to scaphitid microconchs. Furthermore, part of it (GSC loc. 10374) seems to come from the same assemblage containing macroconchs here ascribed to **J. criptonodosus** sp. nov. Most morphological features of both micro- and macroconchs, up to a diameter of c. 20 mm, seem to agree relatively well. Nevertheless, in the only available inner whorls of the macroconchs the ribbing seems to become stronger and the third row of nodes, on the upper third of the flank, is more clearly represented. Furthermore, the incipiently multituberculate stage is more clearly developed in the macroconchs, although this feature occurs on the final half whorl of the adult phragmocone, where sexual differences usually become evident.

The general taxonomic assignment of these microconchs is left under open nomenclature because of the small number of inner whorls of both dimorphs available, and the only tentative inclusion of some of the microconchs here described within this sexual pair.

Thus far, no similar material has been described or figured from North America. The closely related microconchs here included under **J. cf. brevis** (Meek) ♂ differ in their large size and the wider and uniformly finely and densely ribbed body chamber. Their inner whorls are also more densely and finely ribbed and usually devoid of the third row of nodes on the upper third of the flank, although transitional specimens may exist (GSC no. 67102; Pl. 10, figs. 19-21).

In fact, the most similar material so far described in the literature is that from the Kunrade Limestone of South Limburg, The Netherlands, named **Scaphites pungens** Binkhorst (1861, Pl. Va3, fig. 1). This is the species to which Jeletzky (in Cobban and Reeside, 1952; and 1968) tentatively referred some of the specimens here described.

S. pungens has thus far remained a poorly known species, a fact enhanced by Grossouvre's (1908, p. 37) indication about the incorrectness of Binkhorst's figure and the possibility that it would also include finely ribbed specimens (see Grossouvre, 1908, Pl. XI, fig. 1). In that case, **S. pungens** could prove to be a junior subjective synonym of **H. constrictus** Sowerby.

In fact, the microconch of **H. constrictus** ranges from specimens with umbilical tubercles and strongly ribbed flanks (see d'Orbigny, 1840-2, Pl. 129, fig. 10; Binkhorst, 1861, Pl. Vd, fig. 6a; Favre, 1869, Pl. V, figs. 1, 4; Grossouvre, 1908, Pl. XI, fig. 4; Nowak, 1911, Pl. XXXIII, fig. 5) to specimens less strongly ribbed (see Binkhorst, 1861, Pl. Vd, fig. 6d; Schluter, 1872, Pl. XXVIII, fig. 5; Grossouvre, 1893, Pl. 31, fig. 2; Wilckens, 1904, Pl. 17, fig. 4; Nowak, 1911, Pl. XXXIII, fig. 20) and even those with fine ribbing (see Uhlig, 1895, fig. 2; Bohm, 1891, Pl. I, fig. 10; ?Semenov, 1899, Pl. V, fig. 8; Grossouvre, 1908, Pl. XI, figs. 5-7; Bohm and Heim, 1909, Pl. I, fig. 3; Nowak, 1911, Pl. XXXIII, fig. 18). Its representatives also range from less (Schluter, 1872, Pl. XXVIII, fig. 6) to more compressed (see Binkhorst, 1861, Pl. Vd, figs. e-g) in cross-section.

The author had the opportunity to examine plaster casts of the holotype of **Scaphites pungens** (Binkhorst, 1861, Pl. Va3, fig. 1), and small specimens from the same locality and stratigraphic zone kindly provided by L.A. van der Tuuk. The latter has also made available his own observations on the morphological variability of this species. It is concluded that even if the holotype is not so strongly ornamented as indicated in Binkhorst's figure, the tubercles and ribs are more prominent than in **H. constrictus**, in spite of the existence of transitional specimens usually included in **H. constrictus vulgaris** Nowak. These latter may even develop small ventral nodes, a feature clearly represented in **S. pungens**, which is also characterized by the presence of a third row of tubercles in the upper third of the flank.

Whatever the status of this species, all the microconchs ascribed to it, as well as those included in **H. constrictus**, differ from the Canadian material described herein in the following features. **S. pungens** (see Plate 11, figures 22-23) has a deflected body chamber that does not become detached from the phragmocone. This body chamber also has a vertical umbilical wall and a sharp umbilical margin bearing strong tubercles. A conspicuous third row of lateral nodes occurs at its beginning and prominent nodes occur on its venter. The apertural angle of **S. pungens** also seems to be larger than in the Canadian species. The latter also has a more indented suture line, with a more deeply divided lateral saddle in which the branches are somewhat different in size.

H. constrictus lacks tubercles in the phragmocone, a feature consistently present in the Canadian material. It usually has a large (130°) apertural angle and a more finely ribbed, compressed and involute phragmocone.

The similarities between European and Canadian microconchs illustrate quite well the taxonomic problems, which arise when proper consideration is not given to the possible presence of sexual dimorphism. Thus, the fact that microconchs of different species are usually more alike than the macroconchs of the same pairs can lead, when sexual dimorphism is not taken into account, to grouping together microconchs of different species. Such is the case herein when comparing microconchs ascribed to different Canadian species. Consequently, the differences between **J. criptonodosus** ♀ and the European macroconchs included in **H. constrictus** are greater than those existing between the microconchs.

Dimensions (in mm):

	L	D	U	h	w	l
GSC 67107	45	29.5	3.5(0.12)	16.0(0.34)	15.4(0.32)	10.5
GSC 67106	?43.5	22.4	3.8(0.17)	15.1(0.67)	9.2(0.41)	11.3
GSC 67108	42.5	26.4	5.3(0.20)	14.4(0.55)	13.0(0.49)	11.7
GSC 67109	38.6	22.8	3.5(0.15)	12.7(0.56)	9.8(0.43)	9.8
GSC 67111	49	30	4.5(0.15)	16.0(0.53)	13.2(0.44)	15
U.A. 752	44	27.6	5.4(0.20)	15.0(0.54)	15.5(0.56)	11.5

	l/L	H	W	w/h	W/H	A	P	S	In	Ex
GSC 67107	0.23	-	-	0.96	-	-	13	c.78	6	14
GSC 67106	0.26	-	-	0.61	-	-	13	+85	5	c.19
GSC 67108	0.28	15.2	18.4	0.90	1.21	140°	17	c.80	6	19
GSC 67109	0.25	15.5	15	0.77	0.97	-	11	+71	-	13
GSC 67111	0.31	18.8	19	0.83	1.01	-	-	-	-	-
U.A. 752	0.26	-	-	1.03	-	-	c.15	-	c.8	-

Genus **Rhaeboceras** Meek, 1876

Type species: **Phylloceras? halli** Meek, 1876.

Diagnosis: Scaphitid of medium to large size; involute inner whorls and beginning of body chamber becoming progressively more evolute in the last quarter of whorl; varying from compressed to more or less depressed in whorl section throughout ontogeny; fine to coarse primaries, prorsiradiate and becoming divided into, or with intercalated, secondaries in the inner third of the flank. Complex to very complex suture line with very narrow asymmetrically bifid to trifid lateral lobes and narrow, deeply incised lateral saddles.

Comments: **Rhaeboceras** Meek has remained a poorly known genus since it was introduced by Meek (1876) as an alternative for a case in which the tentative assignment of its type species to **Phylloceras** would have otherwise been incorrect.

The similarity of **R. halli** (Meek) with the previously described **"Ammonites opalus"** Owen (1852) was not noticed and the type species of the genus was never figured again on the basis of new material.

More globose and coarsely ribbed relatives were described under **"Ammonites mullanus"** (Meek, 1876), **"Scaphites subglobosus"** Whiteaves (1885), **"Acanthoscaphites albertensis"** Warren (1930) and **"Rhaeboceras whiteavesi"** Landes (in Russell and Landes, 1940). All these species, except the first, were correctly included in **Rhaeboceras** by Landes (op. cit.), although the name had already been accepted as valid by Williams (1930, p. 4-5).

Small-sized species with similar coiling were also described by Warren (1934) under **Ponteixites** Warren, a name that later was considered a synonym of **Rhaeboceras** by Arkell et al. (1957; see below).

On the basis of a personal study of all types and of the material available in Canada it seems advisable to accept as valid **R. halli** (Meek) (including **"Ammonites opalus"** Owen), **R. albertense** (Warren), and **R. subglobosus** (Whiteaves) (including **R. whiteavesi** Landes). This is a group of species with similar type of coiling and suture line, but differing from each other mainly in degree of compression and ornament.

In spite of the similarities of the above **Rhaeboceras** spp. with the species included in **Ponteixites**, these last exhibit some consistent differences, such as a tighter coiling and simpler suture line (see below), besides the smaller size and younger age. The sum total of these features seems to be important enough to maintain **Ponteixites** as a valid taxon.

Rhaeboceras has always been considered to be restricted to the North American Western Interior. It is possible, however, that it attained a wider distribution. Thus, in the Donetz Basin, European U.S.S.R. a species closely related to **R. subglobosus** (Whiteaves) has been described under the name of **"Acanthoscaphites innodosus"** (Naidin, 1974, p. 178, Pl. 62, figs. 1a-b). However, **Ponteixites** seems to be endemic to the Western Interior of North America.

The relationship of **Rhaeboceras** to the scaphitids, dismissed by Meek (1876, p. 461) on the grounds of the lack of detachment of the mature body chamber, has been correctly assumed by Whiteaves (1885), Reeside (1927a), Warren (1930), Williams (1930), and Arkell et al. (1957). Within this group **Rhaeboceras** appears to be closely related to **Acanthoscaphites** Nowak, a relationship that has been stressed by the inclusion within the latter genus of several species later transferred to **Rhaeboceras. Acanthoscaphites,** however, has nodes on the venter of the outer whorl and stronger ornament. These distinctions are further enhanced by the apparent different geographic distribution of both groups. Thus, **Acanthoscaphites** is unknown from North America, while in Eurasia, where it occurs, **Rhaeboceras** is almost totally absent. There is, however, at least one species of **Acanthoscaphites,** i.e. **A. innodosus,** without nodes, and at least one specimen of **Rhaeboceras** from the Western Interior with ventral nodes (see Pl. 13, figs. 9-10). Furthermore, the suture line of some species of **Rhaeboceras** (e.g. **R. subglobosus**) agrees with that of **A. tridens** (see Nowak, 1911, figs. 8-9) not only in complexity and general pattern, but also, and perhaps significantly, in being ascendant towards the umbilical seam and in having a first lateral lobe that is shorter than the external lobe. It seems therefore that the Maastrichtian **Acanthoscaphites** of Europe is a close relative of the Campanian-Maastrichtian North American **Rhaeboceras,** from which it could have originated. Alternatively, both groups could be parallel developments from the **"nodosus-group"**.

Rhaeboceras halli (Meek, 1856)

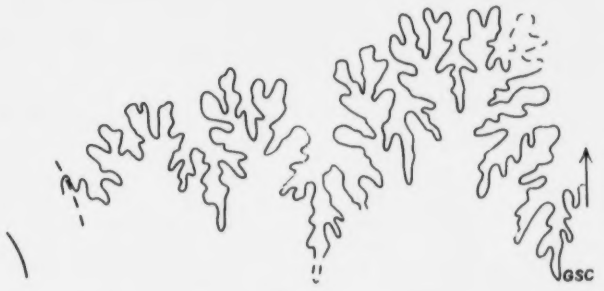
Plate 12, figures 1-6; Plate 13, figures 1-4, 8;
Text-figures 32-35

1852 **Ammonites opalus** (N.S.), Owen, p. 579, Tab. VIII, fig. 6 **(nomen oblitum).**
1856 **Ammonites Haili,** Meek and Hayden, p. 70.
1860 **Ammonites Halli,** Meek and Hayden, p. 420.
1876 **Phylloceras? Halli,** M. & H., Meek, p. 458, Pl. 24, figs. 3a-c.
1930 non **Rhaeboceras halli** Meek, Williams, p. 5 [=**Rhaeboceras albertense** (Warren)].

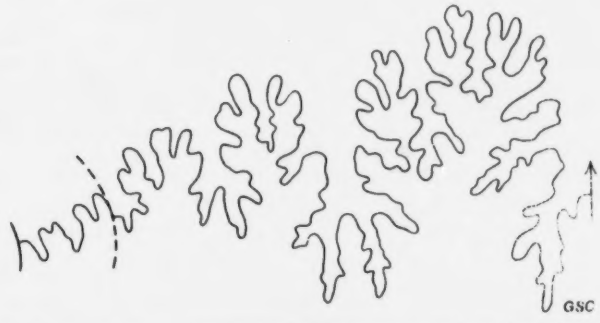
Holotype: By monotypy, the phragmocone with part of the crushed body chamber figured by Meek (1876, Pl. 24, figs. 3a-c; here refigured on Pl. 12, fig. 1-3) from the "Bearpaw Shale, Missouri River, 241.4 km (150 mi) above mouth of Milk River, Montana" (USNM 384).

Diagnosis: Relatively small and very compressed species of **Rhaeboceras,** with fine and dense ribbing, funnel-shaped umbilical walls, and relatively simple suture line, radially oriented and with wide lateral saddles.

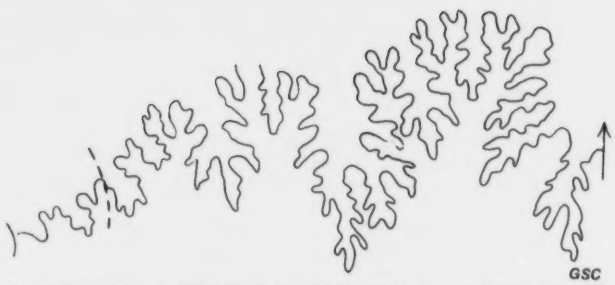
Material: The holotype (USNM 384); the type of **"Ammonites opalus** Owen", from the "Great Bends of the Missouri" (FMN 6377); one complete phragmocone with part of the body chamber (GSC 5370) from Dirt Hills, Saskatchewan (Coll. A. Mowat, 1892; GSC loc. 97995) and one incomplete specimen from "Foxhill Sandstone", Sec. 33, Tp. 1, Rge. 22, W4th, Alberta (Coll. J.S. Irwin, 1930; U.A. 771).



Text-figure 32. ***Rhaeboceras halli*** *(Meek), suture line of holotype, USNM 384, at H = 35.4 mm and W = c. 24.5 mm (see Plate 12, fig. 1-3).*



Text-figure 33. ***Rhaeboceras halli*** *(Meek), suture line of the holotype of* ***"Ammonites opalus*** *Owen", FM 6377, at H = 30.6 mm and W = 21.5 mm (see Plate 13, fig. 1-4).*



Text-figure 34. ***Rhaeboceras halli*** *(Meek), suture line of specimen GSC 5370, at H = 38.1 mm and W = 25.2 mm (see Plate 12, fig. 4-6).*

Description: Complete mature shell of relatively small size for the genus, attaining a maximum diameter of c. 115 mm.

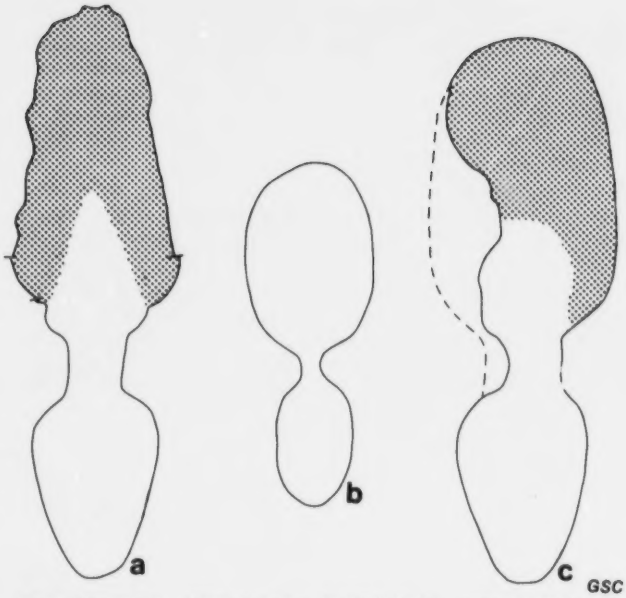
Between shell diameters of 30 and 70 mm, the phragmocone is involute (U/D = 0.11-0.14), with compressed whorl section (W/H = 0.61-0.71), subrectangular in shape and with the maximum width just below the middle of the gently convex flanks. The umbilicus is shallow with funnel-shaped walls which pass into the flanks without forming shoulders. The venter is narrowly arched.

The ornament consists of fine and sharp primary ribs, amounting to 8-10 per half whorl. The ribs begin on the umbilical wall with a slight backward projection. On the lower third of the flanks they are prorsiradiate, and immediately above they become slightly flexuous and divide into 2-3 secondaries. At about the same height 2-3 barely visible secondaries are intercalated between each pair of primaries, which are relatively prominent on the lower half of the flank. Some secondaries become divided farther towards the venter, where the total number of ribs increases to c. 70-85 per half whorl. There all ribs attain similar prominence and acquire a weak adapical concavity.

The adult body chamber, which seems to be more than half of a whorl in length, begins at about 70-75 mm of diameter. The umbilical seam exhibits a weak egression that becomes stronger near the aperture. The whorl section remains compressed and ovate in shape. The number of primary ribs remains constant on the body chamber, although they become more prominent and tend to develop into bullae, from which obscure bundles of secondary ribs originate. These latter become wider but their number per half whorl remains about the same as in the phragmocone.

The suture line (text-figs. 32-34) is moderately complex for the genus, with a graded line of major elements radially oriented. The external lobe is relatively wide and as deep as the narrow and trifid to bifid first lateral lobe. The second lateral lobe is narrow, asymmetrically trifid and appreciably shorter than the first. The first auxiliary lobe, situated near the umbilical shoulder is small, slightly indented, asymmetrically trifid and slightly oblique. Two more oblique, small and simple auxiliary lobes occur on the umbilical wall. The lateral saddles are relatively wide, and E/L saddle is twice as large as L/U_1.

Comments: Thus far, only 3 specimens of this species are known to the author. Two of them are the types of **"Ammonites opalus** Owen" and **"Phylloceras? halli** Meek". The remaining specimen is the only available representative from Canada. All three specimens are remarkably alike, except for the absence of the body chamber in Owen's type.



Text-figure 35. ***Rhaeboceras halli*** *(Meek), cross sections of: a) holotype, USNM 384 (see Plate 12, fig. 1-3); b)* ***"Ammonites opalus*** *Owen", FM 6377 (see Plate 13, fig. 1-4); c) GSC no. 5370 (see Plate 12, fig. 4-6). Body chambers stippled; X0.78.*

This species had previously been mentioned (Meek and Hayden, 1856, p. 70; 1860, p. 420; Meek, 1864, p. 24) as **"Ammonites Halli"**, and Meek (1876) included it in **Phylloceras,** although he noted the sutural differences and the deflected outer whorl. A possible relationship with the scaphitids was dismissed because the outer whorl does not become detached from the phragmocone. Meek (1876) was apparently unaware of the similarities between the inner whorl of his specimen and the phragmocone previously figured by Owen (1852, pl. VIII, fig. 6) under the name **"Ammonites opalus"**. Since then Williams (1930, p. 4-5) described, but not figured, two specimens of **"R. halli** Meek" from the Bearpaw Formation of the South Branch of Boxelder Creek, Saskatchewan. The relationships of this **Rhaeboceras** species to others were discussed by Landes (in Russell and Landes, 1940).

The original material of Owen (1852) has been recently located by the author in the Field Museum of Michigan, and is photographically refigured here for the first time. It closely agrees in all features with the type of **Rhaeboceras halli** (Meek), both specimens belonging therefore to the same species. As Owen's name has not been used since its inception, whereas Meek's has been repeatedly quoted and is considered to represent the type species of **Rhaeboceras** Meek (cf. Arkell et al., 1957, p. L229), it is appropriate to follow Art. 23b of the IC2N and to regard **"Ammonites opalus"** as **nomen oblitum.**

Of the only two specimens from Canada previously ascribed to **R. halli,** and described by Williams (1930, p. 4-5), only one has been found so far by the author thanks to the cooperation of R.V. Best of the University of British Columbia. That specimen, here figured on Plate 18, figures 3-5, has stouter whorl section, coarser and sparser ribbing, steeper umbilical walls, with a deeper umbilicus and

a strongly suspensive and more complex suture line, all features on which it can be clearly separated from **R. halli**, and ascribed instead to **R. albertense** (Warren). The differences between both species will be discussed below.

Dimensions (in mm):

	D	U	H	W	P	S	W/H
1. **R halli**, holotype, USNM 384							
B. ch.	114.8	21.3	56.8	-	? 9	82	-
phrag.	69.6	9.2	37.1	25	13	c.72	0.67
2. **"A. opalus"**, type, FMN 6377							
phrag.	69.6	7.8	38.4	25	10	c.70	0.65
phrag.	44.7	5.5	24.7	17.6	11	c.65	0.71
3. GSC 5370							
B. ch.	111	13.6	58.7	35	8	?70	0.60
phrag.	74	10	40.8	24.9	10	84	0.61

Rhaeboceras aff. **halli** (Meek, 1956)

Plate 13, figures 9-10

Material: One fragment of body chamber (GSC 67112; GSC loc. 97996) from the Bearpaw Formation, Cypress Hills (exact locality and level unknown) (Coll. G.M. Furnival).

Description: Fragment belonging to a specimen of c. 75-80 mm of maximum diameter. The impressed dorsal part of the body chamber indicates that the phragmocone, at c. 35 mm diameter, has a compressed whorl section (W/D = 0.40) and is ornamented by fine and dense ribs.

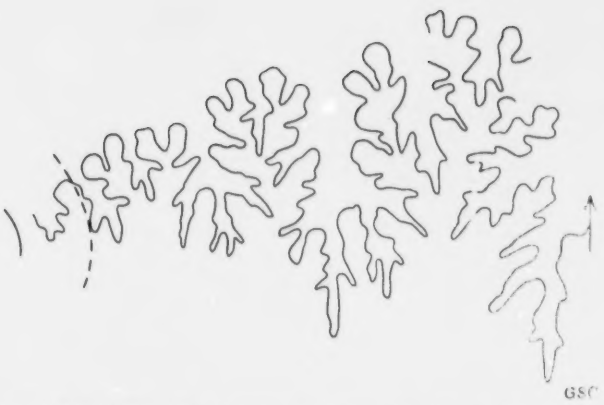
The body chamber exhibits an egression of the umbilical seam but does not become detached from the phragmocone. The whorl section is subovate, higher than wide (W/H = 0.82) with the maximum width on the lower third of the flank. The umbilical wall is inclined outwards and the flanks converge into an evenly rounded venter. On the umbilical margin there are strong tubercle-like bullae, from which fascicules of 4-6 ribs are born. These ribs are prorsiradiate with a very weak flexuosity in the middle of the flank. Secondaries are also intercalated at different heights. All ribs are rounded and become wider and blunter towards the venter. Near the end of the body chamber three rounded and blunt nodes are developed on the ventral area.

Comments: This fragment resembles **R. halli** in all observed features. It differs, however, in the presence of ventral nodes, a feature thus far never described for any species of **Rhaeboceras**. This feature is in fact characteristic of the genus **Acanthoscaphites**. The existence of a specimen of **Rhaeboceras** with ventral tubercles is, therefore, worthwhile reporting, especially since there is at least one record of **Acanthoscaphites** without those tubercles (cf. Naidin, 1974, p. 178, Pl. 62, figs. 1a-b). It is possible, however, that this is a pathological specimen and the ventral nodes may be connected to the lateral injury visible on Plate 13, figure 10, and, therefore, are not taxonomically significant.

Rhaeboceras albertense (Warren, 1930)

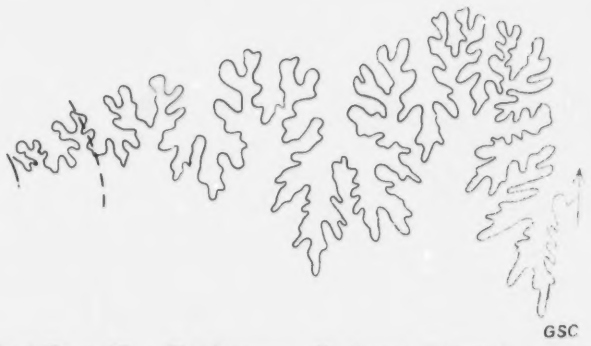
Plate 13, figures 5-7; Plates 14-18;
Text-figures 36-49

1885 **Scaphites abyssinus**, Morton (Sp.), Whiteaves, p. 51.
1930 **Acanthoscaphites albertensis** sp. nov., Warren, p. 23, Pl. II, fig. 1,2; Pl. IV, fig. 2.
1930 **Rhaeboceras halli** Meek, Williams, p. 5.
1940 **Rhaeboceras albertensis** (Warren) Landes, in Russell and Landes, p. 175.

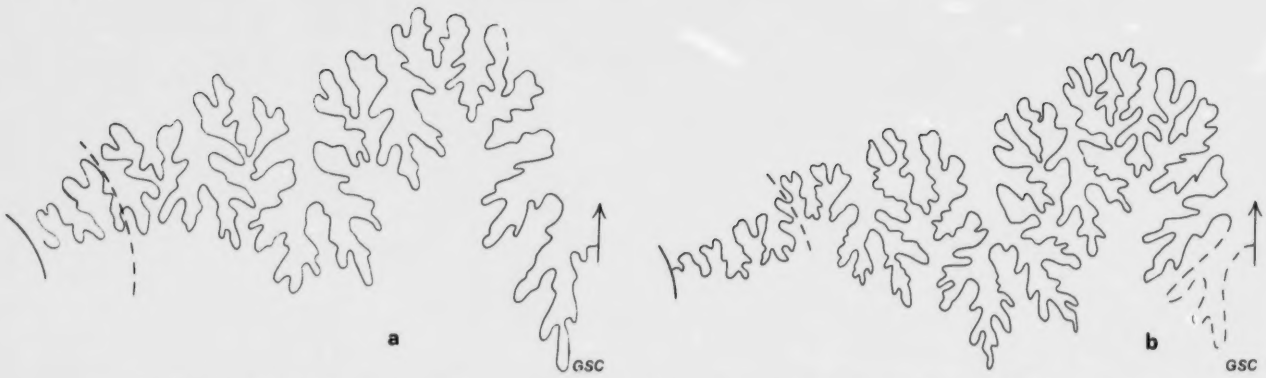


Text-figure 36. ***Rhaeboceras albertense*** *(Warren), suture line of lectotype, UA 349, at H = 26.9 mm and W = 25.2 mm (see Plate 13, fig. 5-7).*

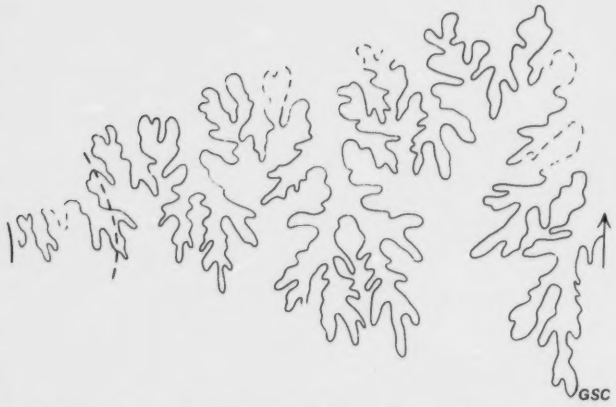
Text-figure 37. ***Rhaeboceras albertense*** *(Warren), suture line of the paralectotype UA 371, at H = c. 31 mm and W = 29.7 mm (see Plate 17, fig. 5-6).*



Text-figure 38. ***Rhaeboceras albertense*** *(Warren), suture line of specimen GSC no. 67113, at H = 45.6 mm and W = 40.8 mm (see Plate 18, fig. 3-5).*

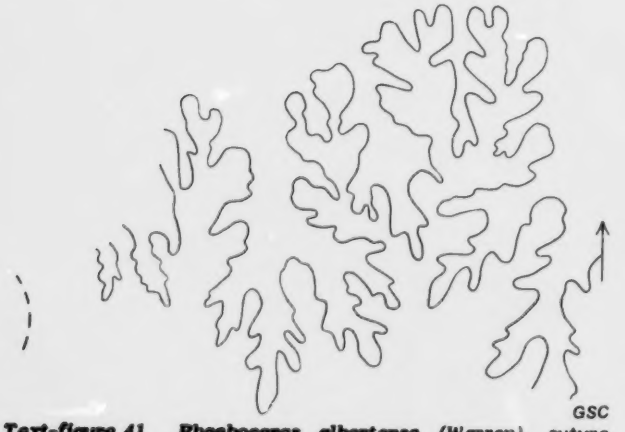


Text-figure 39. ***Rhaeboceras albertense*** *(Warren), suture lines of specimen GSC no. 67116 at: a) H = 12.9 mm and W = 11.3 mm; b) H = 34.7 mm and W = ?36 mm, (see Plate 15, fig. 1-5).*

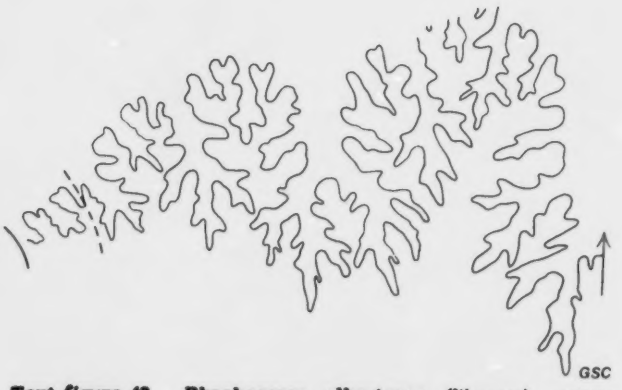


Text-figure 40. ***Rhaeboceras albertense*** *(Warren), suture line of specimen UA 1108 at H = 37.6 mm and W = 32.2 mm, (see Plate 18, fig. 1-2).*

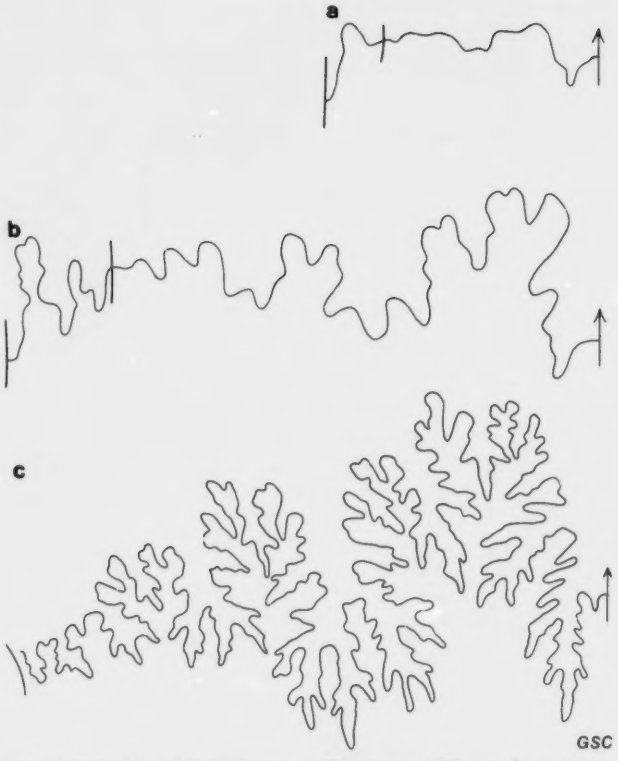
Text-figure 42. ***Rhaeboceras albertense*** *(Warren), suture line of specimen GSC no. 67115, at H = 3 mm and W = 3 mm (see Plate 17, fig. 1-2).*



Text-figure 41. ***Rhaeboceras albertense*** *(Warren), suture line of specimen GSC no. 67115, at H = 28.5 mm and W = 16 mm (see Plate 17, fig. 1-2).*



Text-figure 43. ***Rhaeboceras albertense*** *(Warren), suture line of specimen GSC no. 69592, at H = 21.6 mm and W = 18.8 mm.*



Text-figure 44. ***Rhaeboceras albertense*** *(Warren), suture lines of specimen GSC no. 67118 at: a) W = 1.6 mm; b) H = 2.9 mm and W = 3.4 mm; c) H = 21.1 mm and W = 18.4 mm, (see Plate 14, fig. 6-11).*

Text-figure 45. ***Rhaeboceras albertense*** *(Warren), suture lines of specimen GSC no. 67117 at: a) W = 1.6 mm; b) H = 11.5 mm and W = 11.4 mm; c) H = 24.3 mm and W = 27 mm, (see Plate 14, fig. 1-5).*

Lectotype: Here designated, the complete phragmocone with beginning of the body chamber figured by Warren, 1930, on Plate II, figure 2 and Plate IV, figure 2, here refigured on Plate 13, figures 5-7, from the Bearpaw Formation, Steveville, Alberta (Coll. W.E. Cutler, U.A. 349).

Diagnosis: Medium-sized species of **Rhaeboceras**, with ovate to subquadrate whorl section, becoming as wide as high at the end of the body chamber; has about 30-50 coarse secondary ribs per half whorl at all stages. Complex suture line, with narrow lobes and saddles; external lobe is deeper than the lateral lobe and umbilical elements are ascendant.

Material: The lectotype U.A. 349; the paralectotype U.A. 371, an incomplete specimen consisting of the last quarter of whorl of the phragmocone and the first half whorl of the body chamber, figured by Warren, 1930, on Plate II, figure 1, and here refigured on Plate 17, figures 5-6, from Bearpaw Formation, Steveville, Alberta (S. Davies coll.); a complete phragmocone with beginning of the body chamber (GSC 67113), described by Williams (1930, p. 5) and here figured for the first time on Plate 18, figures 3-5, from the Bearpaw Formation, south branch of Boxelder Creek, Sec. 30, Tp. 10, Rge. 29, W3rd, Saskatchewan (Coll. W.S. Dyer; GSC loc. 97997); one almost complete specimen, and one with almost complete phragmocone and part of the body chamber, and one complete juvenile (?) phragmocone (GSC 67114-5) from c. 152.5-183.0 m (500-600 ft) below top of Bearpaw Formation, McShane Creek, S. 25, Tp. 9, Rge. 27, W3rd, Cypress Hills, Saskatchewan (Coll. G.M. Furnival; GSC loc. 16313); ? one phragmocone with part of the body chamber from 183.0 m (600 ft) below top of Bearpaw Formation, SE 1/4, S. 5, Tp. 10, Rge. 28, W3rd, Cypress Hills, Saskatchewan (Coll. G.M. Furnival; GSC loc. 16316); one incomplete specimen (GSC 67116) from Travers Reservoir, near Vulcan, at opposite end of lake from Little Bow Park (Coll. Mrs. P. James, 1980; GSC loc. 97998); one almost complete, but crushed specimen with part of phragmocone and body chamber missing, from Ponteix, Saskatchewan, GSC 69616 (?Coll. P.S. Warren; GSC loc. 37742); one almost complete adult phragmocone with part of the body chamber, and one complete juvenile (?) phragmocone, GSC 67117-8 from c. 152.5 m (500 ft) above base of Bearpaw Formation, at Manyberries section, Sec. 30, Tp. 5, Rge. 4, W4th (Coll. R.W. Landes, GSC loc. 16396); one incomplete and crushed specimen with end of phragmocone and beginning of body chamber, from near Marklee, south of the town of Elbow, Saskatchewan, GSC 69617 (Coll. J.A. Allan, 1917, GSC loc. 97999); one fragmentary specimen with part of body chamber and phragmocone, from Lethbridge, Alberta (U.A. 15?); one almost complete specimen from uppermost Pale Beds, Lost River, Tp. 1, Rge. 4, W4th, about 3.2 km (2 mi) north of 49th parallel, Coll. by Silver Smoliak (per Dr. Moore, U.A. 1108); one complete adult specimen (GSC 5338) from

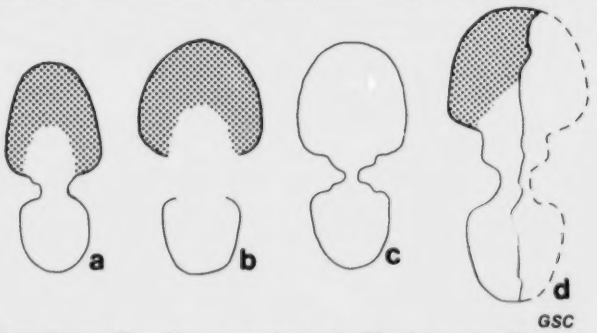
White Mud River (Coll. McConnell, R.G. 1884; GSC loc. 98000); one almost complete adult specimen (GSC 67119) from Frenchman River, Saskatchewan (Coll. F.H. McLearn, 1928; GSC loc. 16334); one almost complete adult GSC 69591, from Cypress Hills, Sec. 18, Tp. 10, Rge. 28, W3rd (G.M. Furnival, 1941; GSC loc. 16328).

Description: Complete adult specimens reach a maximum shell size that seems to range between 120 and 180 mm of diameter; the phragmocone ranging in size between c. 70 and c. 100 mm.

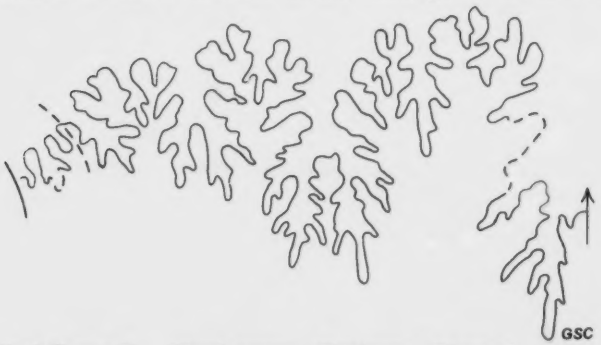
Between 15 and 30 mm of diameter the phragmocone is fairly involute (U/D = 0.20-0.22), with steep, almost vertical umbilical walls. The whorl section is subrectangular in shape with height exceeding width (W/H = 0.88); the maximum width lies in the lower third of the flanks which exhibit a weak convergence towards an almost flat venter. About 8 straight relatively prominent and rounded primary ribs are visible on the upper part of the umbilical wall; they become flexuously prorsiradiate on the flanks, where they are separated by interspaces twice as wide. Secondary ribs are formed at different heights within the middle third of the flank; some of them originate in the primaries, while others are intercalated. Towards the upper part of the flank and venter all ribs, which amount to c. 26 per half whorl, are equally prominent and form a weak adapically concave arch.

Between 45 and 80 mm of diameter the phragmocone becomes relatively more involute (U/D = 0.14-0.18), the umbilical wall is also quite steep and the whorl section retains a similar shape and degree of compression (W/H = 0.79-0.94) by an almost isometric growth of height and width. The venter is rounded. Ribbing also remains similar to that of the inner whorls, although the number of secondaries increases steadily in some specimens (GSC 67117; Pl. 14, fig. 1-5), while it remains almost constant in others (GSC 67116; Pl. 15, fig. 1-5). At the same time there is no evident correlation between whorl width and density of ribbing.

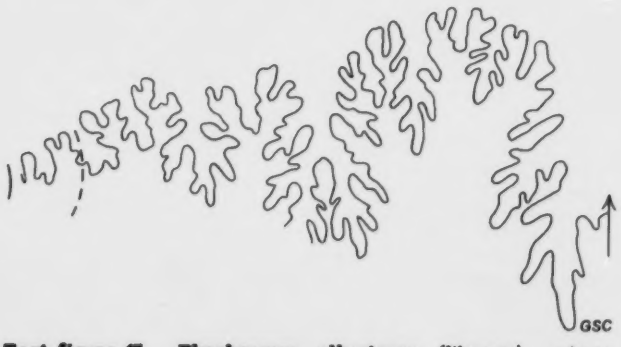
The body chamber is c. 2/3 of a whorl in length. The umbilical seam egresses markedly reaching almost the ventral area of the preceding whorl at the apertural end. The umbilical wall remains vertical, the flanks almost flat and



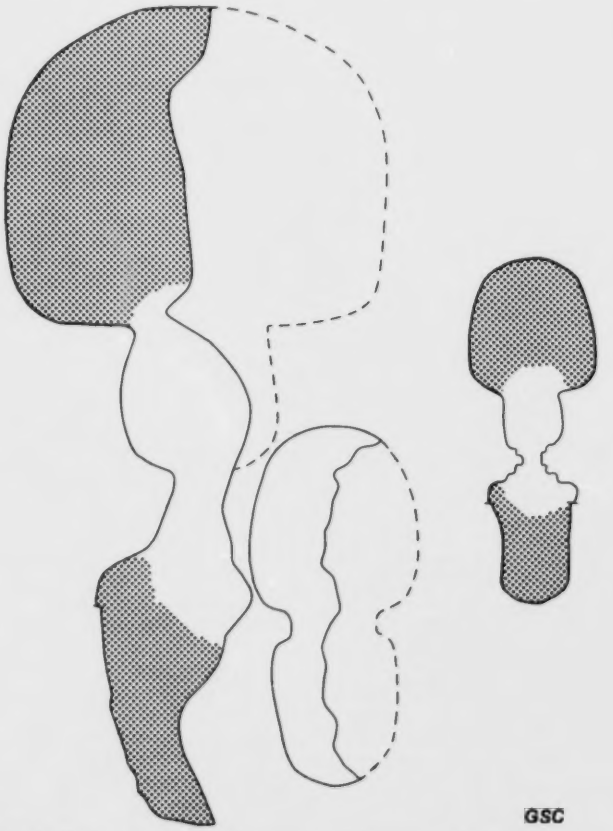
Text-figure 48. *Cross sections of* ***Rhaeboceras albertense*** *(Warren); a) lectotype, UA 349 (see Plate 13, fig. 5-7); b) paralectotype, UA 371 (see Plate 17, fig. 5-6); c) GSC no. 67113 (see Plate 18, fig. 3-5); d) GSC no. 67116 (see Plate 15, fig. 1-5). Body chambers stippled; X0.50.*



Text-figure 46. ***Rhaeboceras albertense*** *(Warren), suture line of specimen GSC 67119, at H = 17.2 mm and W = 13.7 mm (see Plate 17, fig. 7-9).*



Text-figure 47. ***Rhaeboceras albertense*** *(Warren), suture line of specimen GSC no. 5338, at H = 16.6 mm and W = 13 mm (see Plate 17, fig. 3-4).*



Text-figure 49. ***Rhaeboceras albertense*** *(Warren), cross sections of specimens: a) GSC no. 67114 (see Plate 15, fig. 6); b) GSC no. 5338 (see Plate 17, figs. 3-4). Body chambers stippled; X0.70.*

the venter is weakly rounded. Whorl section becomes depressed and about as wide as high (W/H = 0.84-1.30) by negative allometry of height and positive allometry of width. Primary ribs, amounting to 9-10 in the last half whorl develop close to the umbilical margin into narrow and forwardly bended bullae. Secondaries, amounting to 35-49 in the last half whorl, originate as on the phragmocone from or between the primaries, mostly on the lower half of the flanks; they are weakly flexuous and form an adapically concave arch below the middle of the flank; they cross the venter, where they become slightly thicker and almost transversal.

The septal suture (text-fig. 36-47) is quite complex, with narrow bifid to trifid lobes and raised saddles. The first sutures (W < 1.6) are typically quadrilobate, but as growth proceeds several auxiliaries develop by subdivision of the L/U saddle.

The adult suture is complex, with a bifid first lateral lobe, which is narrower, but not as deep, as E. The second lateral lobe is similar but considerably smaller. The auxiliary lobes, which are three in number, are ascendant towards the umbilical margin although they become retracted near the umbilical seam. The saddles are narrow to very narrow and (strongly) denticulate. E/L is deeply bisected and broader than L/U, which is very narrow.

Comments: As pointed out by Warren (1930, p. 24), **R. albertense** is similar to **R. halli** (Meek), from which it, however, differs in ornament and whorl section. Thus, the last species has a consistently more compressed phragmocone (0.61-0.71 vs. 0.79-0.94) and finer and denser ribbing at all stages (70-85 vs. 31-50). **R. albertense** seems to be always more evolute (U/D = 0.14-0.18 vs. 0.11-0.14), and has almost vertical umbilical walls and a deep umbilicus, whereas this is shallower and funnel-shaped in **R. halli**.

It is worth noting the close, but marginal, position in ribbing and the degree of compression, and the relatively small number of the specimens here included in **R. halli**, with respect to the ones ascribed to **R. albertense**. All this suggests the possibility that the two represent extreme morphologic variants of a single species whose more common features are those of the type specimen of **R. albertense**. If so, this last name should be treated as junior synonym of **R. halli**. This conclusion would be supported by an apparent covariation in ribbing and degree of compression, with the most compressed specimens having the finer and denser ribbing. However, those specimens closely resembling the type of **R. albertense** show a wide variation in coarseness and density of ribbing, which does not seem to be correlated with the variation of the whorl section. Furthermore, if despite the apparent lack of correlation between width of whorl section and density of ribbing, it is assumed that variations in these features are intraspecific, then it becomes necessary to apply a similar criterion when differentiating **R. subglobosus** from **R. whiteavesi**. This probably would imply synonymisation of those two names with **R. halli**.

It seems advisable, therefore, to maintain the distinction between **R. halli** and **R. albertense**. In addition to the type of ribbing and degree of compression, they seem also to differ in the whorl section of the body chamber and the suture line. Whereas the whorl section of the body chamber of **R. halli** seems to be relatively compressed, it becomes almost depressed towards the tip in **R. albertense**. This last species also has a relatively more complex suture line, which is straight to slightly ascendant towards the umbilical margin, with narrower lobes and saddles, and a usually bifid L which is not as deep as E. On the other hand, **R. halli** has a relatively retracted and less denticulate suture line, with wider E/L saddle, and a narrowly trifid lateral lobe which is as deep as E.

The lecto- and paralectotype, and most of the specimens here included in **R. albertense**, seem to represent the macroconchs of a possible dimorphic pair. The possible microconchs consist of 2 smaller specimens, that, except for the size, seem to agree in all other features with the more abundant larger specimens. A definite conclusion cannot be drawn due to the paucity of specimens and the fact that they have not been found in association. The size alone does not seem to be evidence enough to introduce a new taxon.

The best preserved of the two smaller specimens (GSC 5338) was included by Whiteaves (1885, p. 51) in "**Scaphites abyssinus** Morton" and said to be closer to the specimen figured by Meek (1876, Pl. 35, fig. 2a) than to Morton's type (1842, Pl. 10, fig. 4). But, as the figures of this last author and Meek's specimen (USNM 409, 17928) show, the similarities are only superficial. The most striking differences are the presence in **D. abyssinus** of two rows of nodes on both sides of the tuberculate venter and a simpler suture line.

Dimensions (in mm):

	D	U	H	W	P	S	W/H
1. Lectotype, U.A. 349							
inc. B. ch.	83	10.2(0.12)	46.9(0.55)	39.5(0.46)	10	39	0.84
end phrag.	70.3	9.5(0.14)	37.2(0.53)	32.0(0.46)	10	40	0.86
phrag.	56.5	7.2(0.13)	31.0(0.55)	27.0(0.48)	10	40	0.87
2. Paralecto-type, U.A. 371							
inc. B. ch.	95	16.5(0.17)	49.5(0.52)	47.0(0.49)	8	28	0.95
end phrag.	c.68.3	11.5(0.17)	37.2(0.54)	33.6(0.49)	-	-	0.90
3. GSC 67113							
end phrag.	91.6	13.5(0.15)	48.6(0.53)	42.0(0.46)	c.9	42	0.86
phrag.	63.4	8.9(0.14)	34.9(0.55)	31.2(0.49)	10	38	0.89
4. GSC 67114							
end B. ch.	c.176	44.0(0.25)	65.5(0.37)	68.8(0.39)	10	42	1.05
end phrag.	99.6	14.6(0.15)	50.0(0.50)	39.4(0.40)	10	30	0.79
5. GSC 67115							
inc. B. ch.	59.6	10.0(0.17)	30.0(0.50)	25.3(0.42)	8	34	0.84
end phrag.	47.4	8.5(0.18)	23.7(0.54)	22.0(0.46)	9	-	0.86
6. GSC 67116							
inc. B. ch.	117.4	27.6(0.24)	51.0(0.43)	50.0(0.43)	9	c.35	0.98
end phrag.	72.2	c.10.0(0.14)	38.6(0.53)	34.0(0.47)	7	32	0.88
phrag.	29.8	6.7(0.22)	14.7(0.49)	12.9(0.43)	7	27	0.88
7. GSC 67117							
inc. B. ch.	165	c.29.0(0.20)	c.69.0(0.48)	+31.0(0.35)	9-10	49	(0.74)
end phrag.	74.5	9.6(0.13)	41.9(0.56)	c.35.0(0.47)	10-11	53	0.84
phrag.	31	5.2(0.17)	17.2(0.55)	15.0(0.48)	9	32	0.87
8. GSC 67118							
end phrag.	38.3	8.9(0.15)	20.5(0.52)	28.7(0.49)	8	36	0.94
phrag.	44.6	6.6(0.15)	24.3(0.54)	21.0(0.47)	9	31	0.86
9. GSC 5338							
end B. ch.	72.9	20.6(0.28)	28.2(0.39)	27.9(0.38)	11	43	0.99
end phrag.	c.43.5	8.0(0.18)	20.7(0.48)	15.7(0.36)	8	(35)	0.76
10. GSC 67119							
end B. ch.	74.7	13.5(0.18)	36.5(0.49)	+23.0(0.31)	78	?38	0.63
phrag.	48.9	8.0(0.16)	26.1(0.53)	16.4(0.34)	7	31	0.63
11. U.A. 136							
inc. B. ch.	c.116	21.4(0.18)	51.5(0.44)	46.5(0.40)	9	35	0.90
end phrag.	c. 76	11.5(0.15)	37.5(0.49)	30.6(0.40)	-	-	0.82
12. U.A. 1108							
inc. B. ch.	144.2	21.7(0.15)	68.0(0.47)	88.5(0.61)	10	52	1.30
end phrag.	102.9	13.9(0.14)	52.6(0.51)	49.5(0.48)	8	48	0.94

Rhaeboceras subglobosus (Whiteaves, 1885)

Plates 19-21; Plate 22, figure 1;
Plate 23, figures 1-3; Text-figures 50-56

1885 **Scaphites subglobosus** (n. sp.), Whiteaves, p. 52, Pl. VII, fig. 3; Pl. VIII, figs. 1,1a (not 2,2a).
1917 **Scaphites subglobosus** Whiteaves, Dowling, p. 32, Pl. XXX, fig. 1-1a (Whiteaves' figure redrawn).
1940 **Rhaeboceras subglobosus** (Whiteaves), Landes, in Russell and Landes, p. 176.
1940 **Rhaeboceras whiteavesi** Landes n. sp., Landes, p. 174, Pl. VI, fig. 9; Pl. VII, fig. 4; Pl. VIII.

Lectotype: The incomplete phragmocone (GSC 5339) figured by Whiteaves, 1885, on Plate 7, figure 3, and here refigured on Plate 19, figures 1-2, from Old Wives Creek, Tp. 10, Rge. 11, W3rd, southern Saskatchewan (Coll. R.G. McConnell, 1884; GSC loc. 97992), by subsequent designation of Elias (1933, p. 315) and Landes (in Russell and Landes 1940, p. 176).

Diagnosis: Large to very large species of **Rhaeboceras** with broad, and usually depressed, whorl section throughout the ontogeny; narrow umbilicus at all growth stages and complex to very complex suture lines.

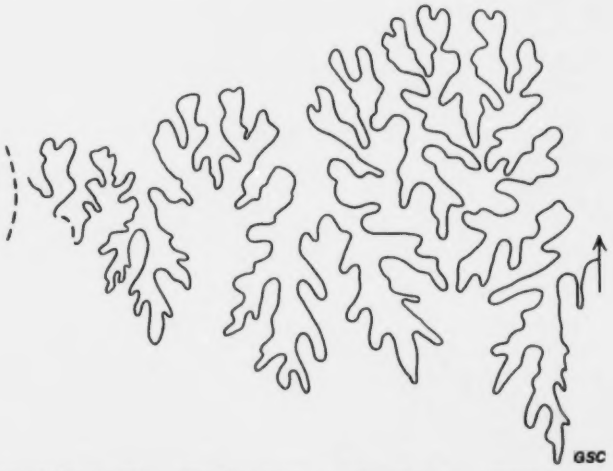
Material: The lectotype, GSC 5339; the paralectotype, a poorly preserved incomplete phragmocone (GSC 5371) from East Branch of the Poplar River, on the 49th Parallel (Coll. G.M. Dawson, 1874; GSC loc. 98001); the holotype of "**Rhaeboceras whiteavesi** Landes", a complete phragmocone with part of the crushed body chamber (GSC 9367), from near the base of the Blood Reserve Sandstone, Pothole Creek, Alberta, SW 1/4, Sec. 34, Tp. 2, Rge. 22, W4th (Coll. R.W. Landes; GSC loc. 98002); the paratype of "**Rhaeboceras whiteavesi**", an incomplete specimen with 1/3 whorl of body chamber, but lacking the end of the phragmocone (GSC 67120), from the Manyberries section, about 45.7 m (150 ft) above Bentonite 8, upper part of the Bearpaw Formation (Coll. R.W. Landes, GSC loc. 16396); part of a body chamber and phragmocone of a large specimen GSC 67121; GSC loc. 97992; and one partially crushed phragmocone GSC 67122; GSC loc. 98002; one very depressed incomplete and distorted phragmocone with part of the body chamber (GSC 69615), and one crushed incomplete phragmocone from Ponteix, Saskatchewan (GSC 69614) (Coll. ?P.S. Warren, 1930; GSC loc. 37742); a fragment of a body chamber and a fragment of a phragmocone, from Berry Creek, Sec. 20, Tp. 29, Rge. 11, W4th (Coll. Al Goldin; U.A. 03945); inner whorls of a phragmocone from an unknown locality (U.A. 756); ?one incomplete phragmocone from Sedalia, Alberta (Coll. Mr. Brekke; U.A. 150); ?one incomplete phragmocone with part of the body chamber from well south of Youngstown, Alberta (D. Bowman, 1931; U.A. 271); several fragments from Cypress Hills, NW 1/4, Sec. 18, Tp. 9, Rge. 28, Sec. 18, Tp. 10, Rge. 28 and SE 1/4, Sec. 17, Tp. 10, Rge. 28, and Sec. 25, Tp. 9, Rge. 27, W3rd (Coll. G.M. Furnival, 1941; GSC loc. 16321, 16328, 16331, 16313); one fragment (GSC 67123) from Frenchman River, south bank, about 1.6 km (1 mi) below McGuiness Ranch (Coll. F.H. McLearn, 1928; GSC loc. 16337).

Description: Shell of large size, with an adult maximum diameter reaching about 250-300 mm.

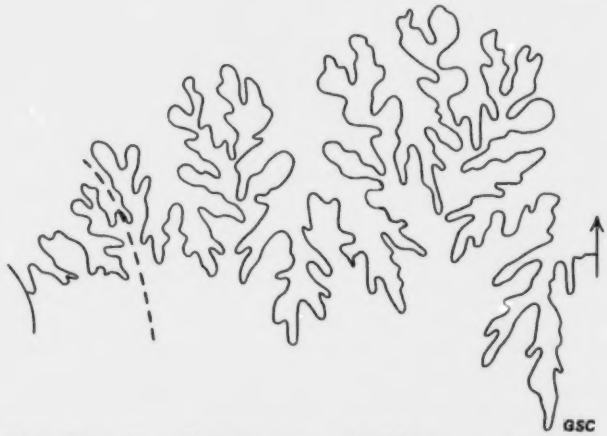
The phragmocone, between 30-60 mm of diameter is strongly involute (U/D = 0.08-0.13) and subglobular in shape. The whorl section is subcircular to transversally ellipsoidal (W/H = 0.93-1.49), with the well rounded lateral shoulder or maximum width at about one-third of the whorl height. The ornament consists of weak to moderately strong ribbing. The primaries, 9-12 per half whorl, are weak and almost straight on the umbilical wall, and become slightly prorsiradiate on the flanks. They increase in strength and bifurcate at the level of the maximum width of the whorl section, where also one or two weaker and simple intercalated secondaries become visible. All ribs, about 29-40 per half whorl, cross the venter with equal strength and almost transversely.

Between 60 and 110 mm of diameter all phragmocones become depressed (W/H > 1.00), the umbilicus seems to be slightly larger (U/D = 0.12-0.17), with an almost vertical wall and a rounded margin. The whorl section has a semicircular to cadicone shape with the maximum width close to the umbilical margin. Ribbing becomes more prorsiradiate and flexuous on the flanks and the number of secondaries varies between 30-50 per half whorl. The maximum diameters of phragmocone range between 105 to 150 mm, and very few, incomplete and deformed body chambers are preserved.

The living chambers seem to maintain most of the features already found in the adult phragmocone. The umbilical seam only appears to have a very small and gradual egression. The whorl section is very depressed. Ribs are strong, rounded and as wide as the interspaces. Most



Text-figure 50. ***Rhaeboceras subglobosus*** *(Whiteaves), suture line of the lectotype, GSC no. 5339, at H = 32.1 mm and W = 43 mm (see Plate 19, fig. 1-4; Text-figure 56a).*



Text-figure 51. ***Rhaeboceras subglobosus*** *(Whiteaves), suture line of the paralectotype, GSC no. 5371, at H = 19.4 mm and W = 22.4 mm (see Plate 20, fig. 2; Text-figure 56c).*

primaries bifurcate on the umbilical shoulder, to form very weak and elongated bullae. Secondary ribs are also born on the lower third of the flank between each succeeding pair of primaries. All secondaries, about 50 per half whorl, are slightly prorsiradiate and form a weak adapically concave bow on the venter.

Suture line (text-figs. 50-55) is complex, with an almost radially oriented imaginary line connecting tops of the saddles. Lateral lobe (L) very narrow, bifid to trifid, either shorter or as deep as the external (E). U shorter than L, bifid to trifid and slightly oblique. The number of auxiliary lobes in advanced sutures varies from three to ?four; they tend to be more or less regularly trifid and straight to weakly retracted. Strongly incised saddles, E/L asymmetrically bipartite with smaller inner branch.

Comments: When **Rhaeboceras subglobosus** was described for the first time, Whiteaves (1885) included two large and several smaller specimens in it. He only figured one of each of these size groups and did not designate the holotype. Since then the small figured specimen (Whiteaves, 1885, Pl. VIII, fig. 2; here refigured on Plate 22, figures 2-4) has been correctly excluded from this species (cf. Elias, 1933, p. 316-7) and Landes (in Russell and Landes, 1940, p. 176-7) has described but not figured, some additional material.

At the same time, this last author erected a new species, **R. whiteavesi**, of which only the holotype was figured, for similarly large and stout shells, which were said to differ from **R. subglobosus** in the more digitate suture and wider than high whorl section.

A restudy of the type material, and all other available specimens, shows that these alleged differences are inconsistent.

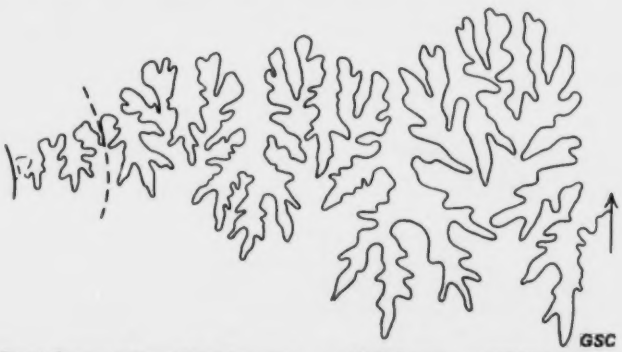
The suture line is similarly complex, as can be seen in the lectotype of **R. subglobosus** and the holotype of "**R. whiteavesi**" (text-figs. 50, 52). The same applies to the paralectotype of **R. subglobosus**, here figured for the first time on Plate 20, figure 2, which also has a less depressed whorl section, similar to that found in the holotype of "**R. whiteavesi**". The paratype of this last "species" is the only available specimen with a more digitate suture line (text-fig. 53), and this feature, is, therefore, considered to be of no significance for Landes' proposed specific distinction.

Similarly, the relative proportions of the cross-section at different stages of development, a character that according to Landes (in Russell and Landes, 1940, p. 175), was found useful for species discrimination does not apply in this case. As pointed out, the paralectotype of **R. subglobosus** has a whorl section similar to that present in the holotype of "**R. whiteavesi**". Furthermore, as can be seen in one of the specimens here described (GSC loc. 37742) and in the lectotype of **R. subglobosus**, with due allowance for secondary deformation, specimens with very depressed outer whorls seem to have less depressed inner whorls. The presence of almost cadicone- or sphaerocone-like inner whorls seems to be quite unusual (e.g. U.A. 756). Its existence, however, together with the fact that all specimens become more depressed at the same ontogenetic stage, suggest that this is a variable feature which can be incorporated at different growth stages. It must be stressed, however, that a proper assessment of this feature is, in part, made difficult by the rather small sample available and the deformation apparent in most specimens.

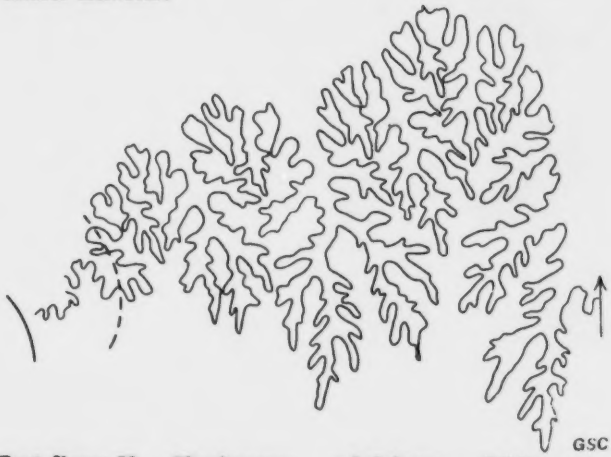
According to Whiteaves (1885, p. 52-3) and Landes (in Russell and Landes, 1940, p. 174-7) **R. subglobosus** and "**R. whiteavesi**" do not have umbilical nodes at any stage of development. Some specimens, however, like the paratype of this last "species" (se Pl. 20, fig. 1) and GSC no. 67122 (Pl. 22, fig. 1) have thickened bullae-like primaries. Furthermore, three incomplete and poorly preserved specimens (GSC 67123, Pl. 20, fig. 3; U.A. 271; U.A. 150) exhibit unmistakably node-like bullae at the umbilical margin. As all other features agree with those here described for **R. subglobosus**, they are tentatively included in this species.

This is particularly important since the absence of nodes was one of the features used by Landes (in Russell and Landes, 1940, p. 175) to distinguish "**R. whiteavesi**" from **R. albertense**. Nevertheless, the distinction of the two still holds on the basis of the more globose and depressed shell of **R. subglobosus** (including **R. whiteavesi**) throughout the phragmocone, and the apparent closely coiled body chamber. The suture line is also more complex in the **R. subglobosus**. These distinctions and the fact that this species includes depressed specimens with a number of ribs similar to that found in the more compressed specimens of **R. albertensis** militates against the inclusion of all three taxa in a single variable species, in which the whorl section is correlated to density of ribbing.

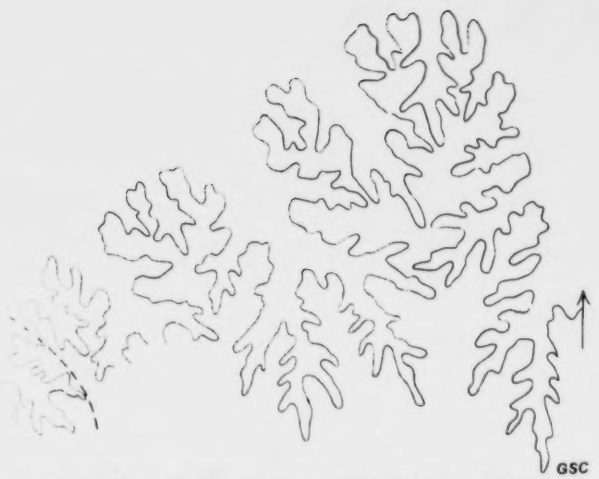
The species from the Donetz Basin described by Naidin (1974, p. 178, Pl. 62, fig. 1a-b) under the name **Acanthoscaphites innodosus** Naidin is very similar to **R. subglobosus**, although it seems to have a narrower umbilicus and a larger number of ribs per half whorl at similar diameter.



Text-figure 52. ***Rhaeboceras subglobosus*** *(Whiteaves). suture line of the holotype of "**Rhaeboceras whiteavesi** Landes", GSC no. 9367, at H = 45.5 mm and W = 49.4 mm (see Plate 19, fig. 3-4; Text-figure 56b).*



Text-figure 53. ***Rhaeboceras subglobosus*** *(Whiteaves). suture line of the paratype of "**Rhaeboceras whiteavesi** Landes", GSC no. 67120, at H = 37.5 mm and W = 33 mm (see Plate 20, fig. 1; Plate 23, fig. 1-3).*

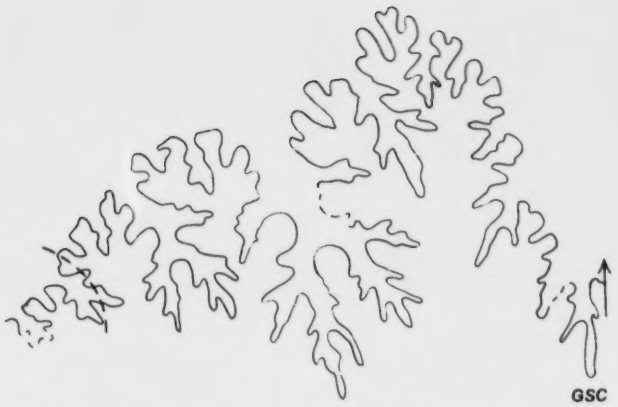


*Text-figure 54. **Rhaeboceras subglobosus** (Whiteaves). GSC 69615, suture line of the inner whorl of specimen at H = 22.5 mm and W = c. 24 mm.*

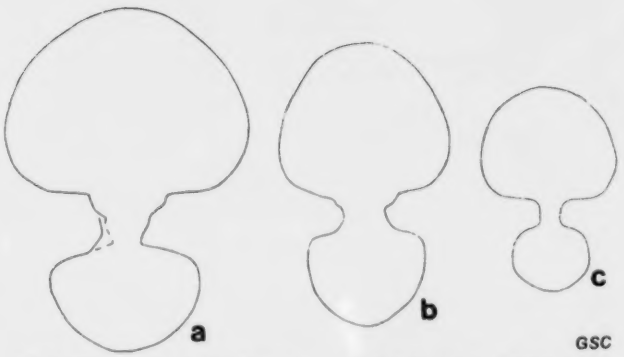
R. subglobosus also has some similarities to the specimen described as "**Ammonites? mullanus** Meek" (1876, Pl. 8, figs. 1a-c), which was said to differ from **Rhaeboceras halli** (Meek) in its less compressed whorl section and coarser ribbing. The similarities with **R. subglobosus** have been pointed out by Stanton (1893, p. 187-9). However, "**A. mullanus**" is a poorly known species based on an incomplete phragmocone and a septate fragment of a larger individual, said to come from the upper part of the Colorado Group, and no new material has become available thus far. Furthermore, the figured specimen appears to differ from **R. subglobosus** in the subquadrate shape of the inner whorls and its coarser and sparser ribbing.

Dimensions (in mm):

	D	U	H	W	P	S	W/H
1. Lectotype, GSC 5339							
Inc. phrag.	125.9	23.0(0.18)	66.0(0.53)	89.2(0.71)	79	40	1.34
	86	14.1(0.16)	40.5(0.47)	60.0(0.70)	8	35	1.48
2. Paralecto-type, GSC 5371							
Inc. phrag.	150	20.0(0.13)	79.0(0.53)	93.0(0.63)	-	(770)	1.20
phrag.	77.6	13.5(0.17)	40.0(0.52)	48.0(0.62)	-	(750)	1.20
3. "R. whiteavesi" holotype, GSC 9367							
end phrag.	104.3	13.9(0.13)	53.9(0.52)	62.0(0.59)	12	52	1.15
phrag.	78.9	10.4(0.13)	41.2(0.52)	47.1(0.60)	10	46	1.14
4. "R. whiteavesi" paratype, GSC 67120							
Inc. B. ch.	170	+20.0(0.12)	96.0(0.55)	+86.7(0.51)	79	50	+0.92
end phrag.	124.7	19.5(0.15)	+75.0(0.60)	72.0(0.58)	-	-	+0.96
phrag.	81.4	9.6(0.12)	41.6(0.51)	43.6(0.54)	10	39	1.05
phrag.	57	7.0(0.12)	29.3(0.51)	28.0(0.49)	9	29	0.96
5. GSC 67122							
Beg. B. ch.	170	29.2(0.17)	-86.0(0.51)	+90.0(0.53)	?10	48	1.05
end phrag.	c.150	27.0(0.18)	-67.4(0.59)	+63.0(0.55)	11	35-40	+0.93



*Text-figure 55. **Rhaeboceras subglobosus** (Whiteaves). GSC 69614, suture line of specimen at H = ?59 mm.*



*Text-figure 56. **Rhaeboceras subglobosus** (Whiteaves). X0.40; cross sections of: a) lectotype, GSC no. 5339 (see Plate 19, fig. 1-4; Text-figure 50); b) holotype of "**Rhaeboceras whiteavesi** Landes", GSC no. 9367 (see Plate 19, fig. 3-4; Text-figure 52); c) paralectotype GSC no. 5371 (see Plate 20, fig. 2; Text-figure 51).*

Genus **Ponteixites** Warren, 1934

Type species: **P. robustus** Warren, 1934, designated herein.

Diagnosis: Shell small, relatively involute throughout, whorl section initially depressed to subcircular and becoming compressed in later stages; ornamented with sparse, rounded and slightly flexuous fold-like ribs which are more prominent on the periphery. Suture relatively simple, straight, with broad subsymmetrically bipartite lateral lobe (L), shallower than E, and subquadratic, relatively very wide saddles.

Comments: **Ponteixites** was introduced by Warren (1934, p. 95) on the basis of two species, i.e. **P. robustus** and **P. gracilis** Warren spp., based on two and three specimens respectively. Its relationship to the scaphitids was noted, as well as the absence of nodes and the almost total absence of straightening of the body chamber, but it was placed within the subfamily **Hoplitinae.** Since then, it has been synonymized with **Rhaeboceras** by Arkell et al. (1957) but was still regarded as an independent genus by Jeletzky (1970). However, no new material has been described or figured. To this day **Ponteixites** has remained poorly known.

The study of the material available in the collections of the GSC confirms the close similarity of **Ponteixites** to **Rhaeboceras** Meek, particularly in the tight coiling of the body chamber. **Rhaeboceras**, however, has a body chamber whose umbilical seam egresses gradually in the last quarter of whorl, while **Ponteixites** remains coiled (almost) to the end. Furthermore, **Ponteixites** remains compressed throughout ontogeny, has sparse and broad, fold-like ribs, and a simple suture line where relatively narrow but stubby lobes are separated by much (up to three times) wider saddles. In contrast, **Rhaeboceras** has a body chamber that becomes depressed near its end, finer and denser ribbing and a more complex suture with extremely long, slender lobes, the branches of which overlap across the more narrow to almost slit-like saddles. Stratigraphically, **Ponteixites** appears to occur in younger beds. It could therefore be a dwarfed descendent of **Rhaeboceras**. Such a conclusion agrees quite well with the character of the external suture line, which closely resembles the juvenile suture of **Rhaeboceras** (compare Text-figs. 61-62 and Text-figs. 44a,b). This could be considered an example of neoteny.

It must also be pointed out that **Ponteixites** shows some similarity to **Desmoscaphites** Reeside, from the Santonian of the Western Interior of North America (see Reeside, 1927b, Pl. 21, figs. 17-21, Pl. 22, figs. 8-12; Cobban, 1951b, Pl. 21, figs. 10-23; 1964, Pl. 1, figs. 1-7; Jeletzky, 1970, Pl. 26, fig. 10) in coiling, whorl section, ornament and simple suture. **Desmoscaphites**, however, is more involute, has constrictions, and no connecting link is known to exist between both genera during most of the Campanian.

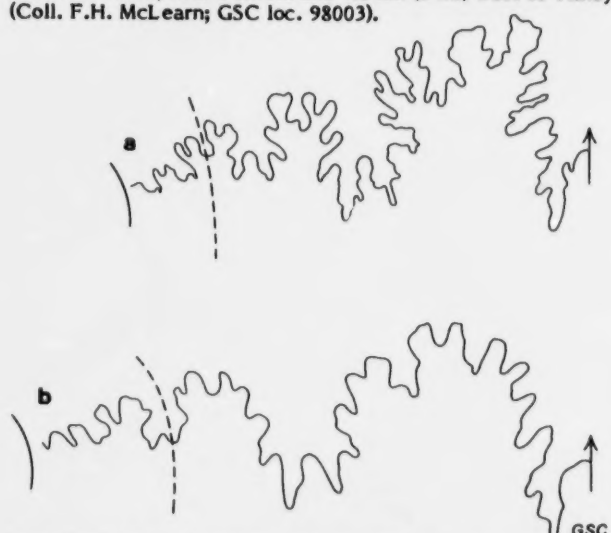
Ponteixites robustus Warren, 1934

Plate 23, figures 4-22; Plate 24, figures 1-9;
Text-figures 57-60

1934 **Ponteixites robustus** sp. nov., Warren, p. 95, Pl. III, fig. 1-4.

1970 **Ponteixites robustus** Warren, Jeletzky, Pl. 27, fig. 1.

Holotype: The almost complete mature specimen (GSC 8738) figured by Warren (1934, Pl. III, figs. 1-2) and here refigured on Plate 23, figures 4-7 from the Bearpaw Formation, Notukeu Creek, near Ponteix and 4.8 km (3 mi) west of Tilney (Coll. F.H. McLearn; GSC loc. 98003).



Text-figure 57. ***Ponteixites robustus*** *Warren, suture lines of: a) holotype, GSC 8738, at H = c. 10 mm and W = c. 10 mm (see Plate 23, fig. 4-7); b) paratype, GSC 8739, at H = 6.3 mm and W = 5.9 mm (see Plate 23, fig. 10-15).*

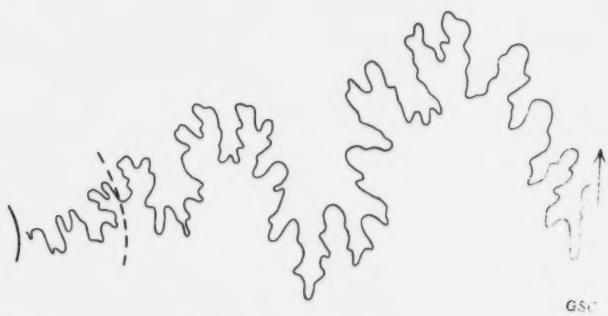
Material: The holotype GSC 8738; the paratype, an incomplete phragmocone (GSC 8739) from the same locality as the holotype GSC loc. 98003; an almost complete adult specimen (GSC 21846) figured by Jeletzky, 1970, Pl. 27, fig. 1, from the headwaters of Moose River or Great Bend Creek, Tp. 2, Rge. 20, W2nd, Saskatchewan (Coll. O.J. Klotz, 1881; GSC loc. 98004); one almost complete adult specimen (GSC 67124) from Belanger Member, c. 28 m (92-93 ft) below top of Bearpaw Formation, northwest side of Cypress Lake, Sec. 14, Tp. 6, Rge. 27, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10395); one almost complete adult (?) GSC 69596 from the Belanger Member, Cypress Hills, NE Sec. 16, Tp. 3, Rge. 25, W3rd, Saskatchewan (Coll. G.M. Furnival, 1940; GSC loc. 10407); three fragmentary adult phragmocones (GSC 67125-7), nine fragments and incomplete, distorted specimens and two innermost whorls, (GSC 69592, cf. text-fig. 59) from west of Tilney, near Ponteix (Coll. P.S. Warren, 1930; GSC loc. 16327); one complete phragmocone with beginning of body chamber (GSC 69597), Belanger Member, North of Robsart, north side of Frenchman River, Sec. 14, Tp. 6, Rge. 25, W3rd (Coll. G.M. Furnival, 1940; GSC loc. 10374); one incomplete phragmocone (GSC 67128) from ?Frenchman River, Saskatchewan (Coll. P.S. Warren, 1928; GSC loc. 17882).

Diagnosis: Relatively large **Ponteixites** with depressed and evolute inner whorls, which become more involute and compressed at the end of the phragmocone and on the body chamber; sparse, very thick and rounded fold-like ribs, amounting to 7-9 primaries and 14-18 secondaries per half whorl.

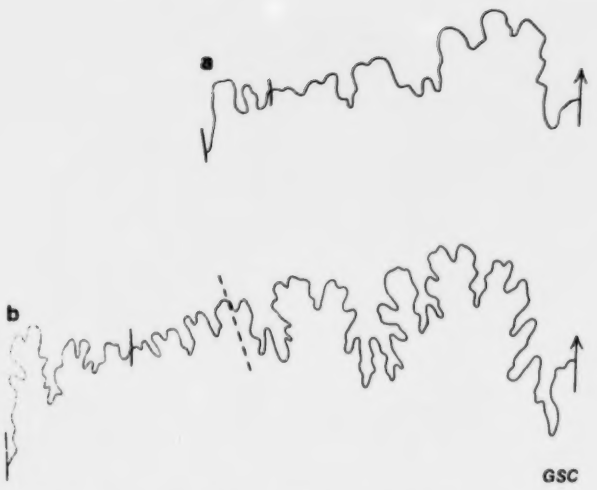
Description: Complete adult specimens with a maximum diameter of 50-55 mm.

The phragmocone, up to 6-7 mm of diameter, is almost smooth. Very fine growth lines cross the umbilical wall with a slight adapertural projection which becomes stronger just below the umbilical margin, they are rursiradiate on the flank and bend forwards again on the venter, where they form a shallow adapically concave arch. These growth lines are accompanied by very weak wrinkles placed about 0.02 mm apart.

Between 7 and 15 mm of diameter the phragmocone is rather evolute (U/D = 0.21-0.34) with depressed and subquadratic to cadiconic whorl section (W/H = 1.05-1.33). The umbilical wall is very high and steeply inclined and passes into a narrowly rounded flank and a broadly curved and almost flat venter. About 7 thick and rounded bullae-like ribs per half whorl are born in the upper part of the umbilical wall; they are separated by interspaces twice as wide and cross the (narrow) flanks with a slight forward projection.



Text-figure 58. ***Ponteixites robustus*** *Warren, suture line of specimen GSC no. 21846, at H = 16 mm and W = c. 14.3 mm (see Plate 23, fig. 8-9).*



Text-figure 59. ***Ponteixites robustus*** *Warren, suture lines of specimen GSC 69592 at: a) H = 2.1 mm and W = 2.7 mm, b) H = 14.9 mm and W = 13.5 mm.*

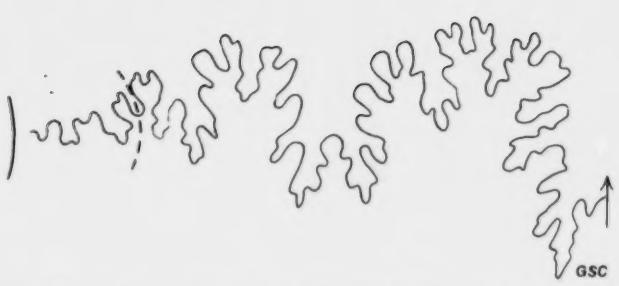
On the venter they become thicker and form an adapically concave bow; at the same time similarly thick secondaries become intercalated between each succeeding pair of primaries.

From 15 mm of diameter up to the end, most adult phragmocones (22-37.7 mm) become relatively involute by negative allometry of U. The whorl section is subquadrate with almost flat to weakly curved flanks, and becomes less depressed and even slightly compressed (W/H = 1.11-0.87) by negative allometry of W (W/D = 0.41-0.48 vs. 0.49-0.53 of previous whorls), and positive allometry of H (H/D = 0.43-0.52 vs. 0.37-0.49). Thus, the phragmocone becomes more involute and compressed throughout the ontogeny. Ribs are thick and rounded and their number and direction remain the same as in previous whorls.

The body chamber is more than half a whorl in length. In most specimens where it is almost complete (e.g. the holotype and GSC 21846) it remains involute, although in the largest specimen available (GSC 67124; Pl. 23, figs. 16-18), a weak egression is partially concealed by deformation of the last quarter of whorl. The whorl section becomes even more compressed (W/H = 0.82-0.98) and the ribbing retains all features already found at the end of the phragmocone, although in the larger specimens the number of primaries and secondaries amounts respectively to 8-9 and 16-18 per half whorl. The aperture is unknown.

The suture line (text-figs. 57-60) is rather simple, with almost radially oriented saddles and umbilical elements. The lateral lobe (L) is relatively wide, subsymmetrically bifid and not as deep as the external lobe (E). U_1 is even shorter and also bifid and sometimes slightly oblique. The saddle E/L is simple, as wide as high and twice as large as L/U_1.

Comments: This species seems to vary considerably in several features. Thus, the paratype and two other specimens are extremely evolute when compared with all the other available material. The end of the adult phragmocone and the maximum size seems also to be rather variable, as illustrated by the holotype and specimen GSC 67124 (Pl. 23, figs. 16-18) which also differs from the former specimen in the more flattened flanks and squarish whorl section. It also has fewer, 12 vs. 18, secondaries and stronger ribs in the last half whorl.



Text-figure 60. ***Ponteixites robustus*** *Warren, suture line of specimen GSC no. 67124, at H = 15.8 mm and W = 15 mm (see Plate 23, fig. 16-18).*

The striking difference in size of the few complete adults suggests the possible existence of sexual dimorphism. Distinction, however, is not clear due to the relatively large morphological variation also present in the innermost whorls of the phragmocone.

Dimensions (in mm):

	D.	U	H	W	P	S	W/H
1. Holotype, GSC 8738 complete(?)							
B. ch.	41	8.2(0.20)	20.8(0.51)	18.3(0.45)	6	12	0.88
end phrag.	28.5	6.3(0.22)	12.5(0.44)	12.0(0.42)	6	11	0.96
2. Paratype, GSC 8739							
inc. phrag.	29.3	7.2(0.30)	10.3(0.43)	11.7(0.48)	6.7	11	1.11
phrag.	17.6	4.7	7	7.9			
3. GSC 21846							
Inc. B. Ch.	46.8	7.8(0.17)	23.3(0.50)	19.2(0.41)	8	16	0.82
end phrag.	35	6.3(0.18)	15.7(0.45)	14.5(0.41)	7	16	0.92
4. GSC 67124 complete(?)							
B. ch.	52.7	9.8(0.19)	26.4(0.50)	26.0(0.49)	9	18	0.98
end phrag.	37.7	6.6(0.18)	19.5(0.52)	17.0(0.45)	9	15	0.87
phrag.	20.5	4.3(0.21)	9.5(0.46)	10.3(0.50)	-	-	1.08
5. GSC 67123							
inc. phrag.	c.35	9.6(0.27)	14.0(0.40)	16.4(0.47)	9	13	1.17
6. GSC 67126							
Inc. B. ch.	13	4.2(0.28)	6.9(0.46)	8.0(0.53)	7	14	1.16
phrag.	11	3.4(0.31)	4.3(0.39)	5.5(0.50)	-	-	1.28
7. GSC 67127							
Inc. B. ch.	10.6	3.6(0.34)	3.9(0.37)	5.2(0.49)	6	11	0.75
8. GSC 67128							
Inc. phrag.	21	5.2(0.21)	9.9(0.47)	9.8(0.47)	7	14	0.99
phrag.	11.8	3.4(0.29)	5.2(0.44)	5.8(0.49)	7	14	1.21

Ponteixites gracilis Warren, 1934

Plate 24, figures 10-43; Text-figure 61

1934 **Ponteixites gracilis** sp. nov., Warren, p. 96, Pl. III, figs. 5-9.

1940 **Ponteixites gracilis** Warren, Landes in Russell and Landes, p. 180.

Holotype: The complete mature phragmocone with beginning of the body chamber (GSC 8740) figured by Warren, 1934, Pl. III, fig. 5, and here refigured on Plate 24, figure 14-19, from Notukeu Creek, near Ponteix and 4.8 km (3 mi) west of Tilney (Coll. P.S. Warren, 1930; GSC loc. 98005).

*Text-figure 61. **Ponteixites gracilis** Warren, suture lines of: a) paratype, GSC 8741b at H = 5.2 mm and W = 5 mm; b) GSC no. 67131 at H = 7.5 mm and W = 6.3 mm, (see Plate 24, fig. 42-43); c) GSC no. 67132 at H = 3.6 mm and W = 3.8 mm, (see Plate 24, fig. 10-11).*

Diagnosis: Small **Ponteixites**, with relatively narrow and shallow umbilicus; subcircular to subquadrate whorl section, slightly compressed; relatively numerous ribs, flexuous and weaker on the flanks but becoming stronger on the venter where they are strongly projected towards the aperture.

Material: The holotype; the paratypes, two complete adult phragmocones with beginning of the body chamber, from the same locality as the holotype (Coll. P.S. Warren, 1930; GSC 8741a-b); one almost complete mature specimen (GSC 67129) and one complete phragmocone with beginning of the body chamber from ?Frenchman River, Saskatchewan (Coll. P.S. Warren; GSC loc. 17882/1-2); one incomplete phragmocone (GSC 67130) and one poorly preserved fragment from SE 1/4, Sec. 23, Tp. 10, Rge. 20, W2nd, Saskatchewan (Coll. R. Graham, 1936; GSC loc. 10437); two incomplete phragmocones from Belanger Member, c. 28 m (c. 92-93 ft) below top of Bearpaw Formation, northwest side of Cypress Lake (Coll. G.M. Furnival, 1940; GSC loc. 10395); three incomplete phragmocones, one crushed specimen and one fragment of large whorl from 4.8 km (3 mi) west of Tilney, Saskatchewan (Coll. P.S. Warren, 1930; GSC loc. 16327); 26 phragmocones with beginning of the body chamber, one fragment of body chamber of a large specimen, three small incomplete phragmocones (GSC 67131-3) and 21 fragments of (mostly) inner whorls, from Ponteix, Saskatchewan (Coll. P.S. Warren; GSC loc. 16326).

Description: Small complete adult shell, ranging in diameter between 14 and 26 mm.

The adult phragmocone exhibits a range of size variation that is as wide as that of **P. robustus** but with most specimens reaching shell diameters between 8 and 20 mm.

The inner whorls, at diameters smaller than 11-12 mm are fairly involute (U/D = 0.19-0.27), with a round outwardly inclined umbilical wall. The whorl section is subcircular, almost as high as wide, usually slightly depressed (W/H = 1.02-1.08) in the innermost whorls (D < 8.3) and becoming compressed (W/H = 0.84-1) as growth proceeds.

The flanks and venter are rounded with the maximum width below the center of the flank, and there is no evidence of umbilical and ventrolateral shoulders.

Up to 8 mm in diameter the internal mould is smooth and only where the shell has been preserved are faint growth lines visible. They are straight on the lower part of the umbilical wall and bend weakly, forward and backwards, before reaching the maximum whorl width. On the outer part of the flank they become prorsiradiate to cross the venter forming an adapically concave arch. As growth proceeds, broad and round fold-like primary ribs gradually appear on the flanks. Close to the umbilical wall there are c. 7-8 of them per half-whorl. They are separated by interspaces almost twice as broad and have a flexuosity similar to that described for the growth lines. They are slightly more prorsiradiate and become progressively wider towards the venter, while immediately above the maximum whorl width a secondary rib is usually intercalated between every second primary. On the venter there are about 14-16 ribs per half whorl, which are low and about as broad as the interspaces.

At diameters larger than 11-12 mm the phragmocone and body chamber remain involute (U/D = 0.19-0.24). The whorl section is slightly compressed (W/H = 0.84-1), but its shape becomes subquadratic to subrectangular, with a more inclined umbilical wall and shallow umbilicus, and less rounded and almost parallel flanks. The maximum whorl width is now close to the venter in the upper half of the flanks. Ribbing remains the same as in previous whorls, with the number of primaries and secondaries amounting respectively to 6-10 and 14-20 per half whorl. All ribs become very prominent on the venter where they are strongly bent towards the aperture.

The suture line is simple, with almost radially oriented saddles and umbilical auxiliaries. The lateral lobe (L) is wide, subsymmetrically bifid and not as deep as the external lobe (E). U_1 is even shorter and also bifid. The E/L saddle is simple, as wide as high and more than twice the size of L/U. The first sutures have only four lobes, I, U, L, E, all successive auxiliaries arising through splitting of U/L.

The complete aperture is not preserved.

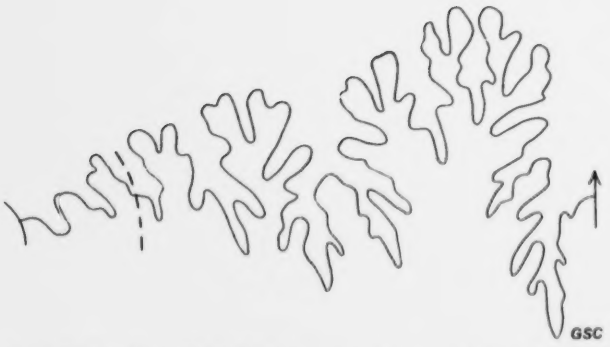
Comments: When Warren (1934, p. 96) introduced this species no comparison with the closely related **P. robustus** Warren was attempted. Most differences however, were evident from his descriptions and/or measurements of both species.

Thus, **P. gracilis** seems to be not only consistently smaller in size than **P. robustus**, but it also has a more compressed whorl section, especially in the body chamber, and narrower and shallower umbilicus, as well as a slightly larger number of ribs per half whorl.

The otherwise close similarity between both species and the fact that in some localities, at least, they have been found together, suggest that this could be another case of sexual dimorphism. The recorded differences, however, seem to be quite consistent, not only for the adult body chamber but also for the juvenile phragmocone whorls, unless the few available inner whorls of **P. robustus** do not represent the true variation of the species; or because of the small size of **P. gracilis**, the similarities between the two possible members of this dimorphic pair are restricted to the innermost whorl, where they are insignificant for taxonomic purposes.

Dimensions (in mm):

	D	U	H	W	P	S	W/H
1. Holotype, GSC 8740 end phrag.	19.2	3.6(0.19)	9.6(0.49)	9.0(0.47)	9	19-20	0.94
2. Paratype, GSC 8741a inc. B. ch.	17.6	3.7(0.21)	8.0(0.45)	7.5(0.40)	8	15	0.89
end phrag.	c.12	2.3(0.19)	5.5(0.46)	5.0(0.42)	-	-	0.91
3. Paratype, GSC 8741b inc. B. Ch.	16.9	3.4(0.20)	7.9(0.47)	7.7(0.46)	8	14-13	0.97
end phrag.	12	2.3(0.21)	5.7(0.48)	4.8(0.40)	-	-	0.84
4. GSC 67129 inc. B. ch.	26	5.0(0.19)	12.0(0.46)	9.4(0.36)	9	19	0.78
5. GSC 67130 inc. phrag.	21.9	4.2(0.19)	10.7(0.49)	8.3(0.39)	-	17	0.79
phrag.	14.6	3.2(0.22)	7.4(0.51)	6.1(0.42)	-	-	0.82
phrag.	9.2	2.5(0.27)	4.5(0.49)	4.5(0.49)	-	-	1



Text-figure 62. *?**Ponteixites** sp. nov., suture line of specimen GSC no. 67134 at H = 10 mm and W = 9.4 mm, figured on Plate 24, figs. 44-46.*

Ponteixites (?) sp. nov.

Plate 24, figures 44-49; Text-figure 62

Material: Two incomplete phragmocones (GSC 67134-5) from Berry Creek, Sec. 11, Tp. 27, Rge. 12, W4th (Coll. L.S. Russell, 1931; GSC loc. 16457).

Description: Incomplete phragmocone relatively evolute (U/D = 0.25-0.27) with inclined to subvertical umbilical wall. Whorl section subquadrate to subrectangular, at first almost as wide as high, and later becoming more compressed (W/H = 0.91 → 0.75). At smaller diameters the flanks are slightly convex passing gradually into the inclined umbilical wall. Later they become flat and almost parallel, with a more defined but rounded umbilical margin. The venter is weakly convex throughout.

About 18 to 21 ribs are present on the umbilical margin. They are separated by interspaces about twice as broad and are prorsiradiate. In the middle of the flank they form a weak adapical concavity to become more strongly projected on the ventrolateral margin. Secondary ribs become intercalated at different flank heights, and about 38-47 rounded ribs cross the venter with a forward projection. They are as wide as the interspaces and become progressively less projected as growth proceeds.

The suture line (text-figure 62) is relatively complex, with an almost radially oriented imaginary line connecting tops of the saddles and those of the umbilical auxiliaries. The lateral lobe (L) is narrow, subsymmetrically bifid and half as deep as the external lobe (E). U_1 is even shorter and trifid. The E/L saddle is incised and higher than wide.

Comments: The described specimens seem to agree in several features with **Ponteixites robustus** and **P. gracilis**, even if a detailed comparison is not possible due to the incompleteness of the material available. Thus, they agree with **P. robustus** in the degree of evolution, but have a whorl section even more compressed than **P. gracilis**. The ribbing is similar to that of the latter species, although it becomes relatively finer and less flexuous at larger diameters. The suture line has also radially oriented saddles and umbilical elements similar to those present in **P. robustus** and **P. gracilis**.

However, besides the above mentioned differences, the material here described has a subrectangular whorl section, with subvertical umbilical wall and almost parallel flanks and the complexity of its suture line is larger than in both formally named **Ponteixites** species.

Dimensions (in mm):

	D	U	H	W	W/H	P	S
1. GSC 67134 inc. phrag.	30	7.5(0.25)	15.0(0.50)	11.2(0.37)	0.74	21	47
phrag.	22.4	6.2(0.27)	10.3(0.46)	9.6(0.42)	0.91	19	41
2. GSC 67135 inc. phrag.	25.6	6.4(0.25)	13.2(0.51)	9.9(0.38)	0.75	18	38

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Unless otherwise stated in caption, all figures shown in Plates 1-26 are natural size.

PLATE 1

Figures 1-11. **Hoploscaphites** sp. α

1-2. Complete specimen with crushed end of body chamber, U.A. 7070. From Notukeu Creek, near Cadillac, Saskatchewan. Lateral (1) and ventral (2) views.

3-5. Incomplete specimen, GSC 67087, GSC loc. 16395, from 91.5 m (300 ft) above base of Bearpaw Formation, Manyberries section, Sec. 30, Tp. 5, Rge. 4, W4th, Alberta, Coll. R.W. Landes. (3) Lateral view of complete specimen. (4) Lateral view of inner whorl from the side concealed in Fig. 3. (5) Ventral view of the inner whorl shown in Fig. 4.

6-9. Incomplete specimen, GSC 67088, from same locality and horizon as figs. 3-5. Apertural (6), ventral (7) and lateral (8,9) views.

10-11. Incomplete phragmocone, GSC 67089. Same locality and level as for figs. 3-5. Lateral (10) and apertural (11) views.

Figures 12-22. **Hoploscaphites landesi** sp. nov.

12-14. Holotype, almost complete specimen, GSC 5342/a, GSC loc. 97988, from ?Demaine Member, South Saskatchewan River opposite mouth Swift Current Creek, Sask. Coll. T.C. Weston. Ventral (12), lateral (13) and apertural (14) views.

15-17. Complete but crushed specimen. GSC 5342/b, same level and locality as the holotype. Lateral (15), apertural (16) and ventral (17) views.

18-19. Fragment of body chamber. GSC 5342/d. Same level and locality as the holotype. Lateral (18) and ventral (19) views.

20-22. Complete specimen. GSC 5342/c. Same level and locality as the holotype. Ventral (20), apertural (21) and lateral (22) views.

Figures 23-26. **Hoploscaphites** sp. indet.

23-24. Body chamber. GSC 67091, GSC loc. 17925. Medicine Lodge Coulée, SE 1/4, Sec. 7, Tp. 8, Rge. 3, W4th. Coll. R.W. Landes. Ventral (24) and lateral (23) views.

25-26. Almost complete specimen. GSC 67092, GSC loc. 10416. Belanger Member, NW of Old Man On His Back Plateau, Cypress Hills, Saskatchewan. Coll. G.M. Furnival. Lateral (25) and ventral (26) views.

Figures 27-29. **Hoploscaphites** sp. β. Phragmocone with part of body chamber. GSC 67090, GSC loc. 10437. SW of Milestone, SE 1/4, Tp. 10, Rge. 20, W2nd, Saskatchewan. Coll. R. Graham, 1936. Lateral (27), ventral (28) and apertural (29) views.

Figure 30. **Hoploscaphites** sp. nov.? GSC 67136 – Lea Park Formation, Vanscoy Shaft, depth 154.0-155.5 m (505-510 ft). GSC loc. 73499; lateral view.

Plate 1

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PLATE 2

Figures 1-8. **Jeletzkytes nodosus** (Owen).

1-3. Holotype. FM 6381. Sage Creek, tributary of the Cheyenne, Gurley Coll. Lateral (1), ventral (2) and apertural (3) views.

4-8. Incomplete specimen. GSC 5369/a; GSC loc. 97990. Elbow of Saskatchewan River, Coll. J. Macoun, 1879. Lateral (4), ventral (5) and apertural (6) views of the whorl. Lateral (7) and apertural (8) views of the terminal inner whorl.

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PLATE 3

Figure 1. **Jeletzkytes** cf. **nodosus** (Owen). Crushed incomplete specimen. GSC 5367, GSC loc. 97991. South Saskatchewan River, opposite mouth of Swift Current Creek, Saskatchewan. Coll. R.G. McConnell, 1882. Lateral view.

Figures 2-6. **Jeletzkytes** aff. **nodosus** (Owen). Complete mature specimen. U.A. 748. North side of Milk River, near Groton, Tp. 3, Rge. 10, W4th. Coll. J.A. Allen. 2-3, Lateral (2) and apertural (3) views of a complete specimen; 4-6, outer whorl removed, lateral (4), ventral (5) and apertural (6) views.

Plate 3

PLATE 4

Figures 1-2. **Jeletzkytes** aff. **nodosus** (Owen). U.A. 03944, almost complete specimen. Locality unknown, Alberta. Lateral (1) and ventral (2) views.

Figures 3-4. **Jeletzkytes** cf. **furnivali** sp. nov.
Complete phragmocone. GSC 67094; GSC loc. 16330. Cypress Hills, 1/4 Sec. 7, Tp. 10, Rge. 28, W3rd, Saskatchewan. Coll. G.M. Furnival. Ventral (3) and lateral (4) views.

Figure 5. **Scaphites tuberculatus** Giebel. Complete body chamber. NLB. Kca38, Jlten, near Hannover, FDR. Highest Upper Campanian. Coll. Ruand (Braunschweig). Lateral view.

Figure 6. **Scaphites tuberculatus** Giebel. Complete body chamber with part of phragmocone. NLB Kca 25. Baugrube SE Rand von Ahlten TK 25, Blatt Lehrte, Nr. 3625. Coll. U. Petsch, 1975. Lateral view.

Figures 7-9. **Jeletzkytes furnivali** sp. nov. Holotype. GSC 67093; GSC loc. 16316. From 183 m (600 ft) below top of Bearpaw Formation, near McCoy Creek, Cypress Hills, SE 1/4, Sec. 5, Tp. 10, Rge. 28, W3rd, Saskatchewan. Coll. G.M. Furnival. Ventral (7), apertural (8) and lateral (9) views.

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PLATE 5

Figures 1-2. **Jeletzkytes brevis** (Meek). Holotype. Photograph of the plaster cast. USNM 367. Pierre Shale, Yellowstone River, near Miles City, Montana. Lateral (1) and ventral (2) views.

Figures 3-9. **Jeletzkytes** cf. **brevis** (Meek)♀

3-4. Complete specimen. U.A. 1199. Belanger Member, Notukeu Creek, east of Ponteix, Sec. 28, Tp. 9, Rge. 11, W3rd. Coll. P.S. Warren. Lateral (3) and ventral (4) views.

5-7. Complete specimen. GSC 21852, Frenchman (?) River, Saskatchewan. Coll. P.S. Warren, 1928; GSC loc. 97993. Lateral (5) and two ventral (6 and 7) views.

8-9. Complete crushed specimen (GSC 67099). ?Swift Current Creek, NE Sec. 35, Tp. 13, Rge. 15, W3rd, Saskatchewan (Coll. P.S. Warren; GSC loc. 97994); apertural (8) and lateral (9) views.

Plate 5

PLATE 6

Figures 1-4. **Jeletzkytes** aff. **brevis** (Meek). ♀ Complete mature specimen (GSC 5368); Dirt Hills, Saskatchewan (GSC 97995). Lateral (1), and ventral (2) views. Cross-section of inner whorls (3) and apertural view (4).

Figures 5-9. **Jeletzkytes** cf. **brevis** (Meek) ♀

5-7. Complete phragmocone with beginning of body chamber. GSC 67097; GSC loc. 10407. Cypress Hills, NE Sec. 16, Tp. 3, Rge. 25, W3rd. Coll. G.M. Furnival 1940. Ventral (5), apertural (6) and lateral (7) views.

8-9. Phragmocone. GSC 67098. Same locality and level as last. Ventral (8) and lateral (9) views.

Figure 10. **Jeletzkytes criptonodosus** sp. nov. ♀ Holotype. GSC 67104, GSC loc. 10374. Belanger Member. North side of Frenchman River, just west of road from Caton's ranch to Robsart, Sec. 14, Tp. 6, Rge. 25, W3rd, Saskatchewan. Coll. G.M. Furnival, 1940. Lateral view.

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PLATE 7

Figures 1-2. **Jeletzkytes criptonodosus** sp. nov. ♀ Holotype. GSC 67104; GSC loc. 10374. See description of Pl. 6, fig. 10 for further details. Ventral (1) and apertural (2) views.

Figures 3-5. **Jeletzkytes** cf. **crassus** (Coryell and Salmon). Incomplete specimen. GSC 67095; GSC loc. 19429. Manyberries section, Cypress Hills, Alta. Collected 45 m (150 feet) above Bentonite No. 8, Coll. R.W. Landes. Lateral (3), and ventral (4) views. Cross-section of whorls (5).

Plate 7

PLATE 8

Figures 1-4. **Jeletzkytes** cf. **crassus** (Coryell and Salmon). Incomplete specimen. GSC 67096; GSC loc. 10407. Belanger Member, Cypress Hills, NE Sec. 16, Tp. 3, Rge. 25, W3rd, Saskatchewan. Coll. G.M. Furnival 1940. Lateral (1) and apertural (2) views of outer whorls. Lateral (3) and ventral (4) views of inner whorls.

Figures 5-6. "**Acanthoscaphites duplico-nodosus** Coryell and Salmon". Holotype. AMNH 24235. Top of Pierre Formation at Glendive (T14N, R55E), Dawson Co., Montana. Coll. T. Wasson, 1930. Lateral (5) and ventral (6) views.

Figures 7-9. **Jeletzkytes criptonodosus** sp. nov. o Paratype. GSC 67105; GSC loc. 10374. Saskatchewan, Sec. 14, Tp. 6, Rge. 25, W3rd. West of Robsart, Saskatchewan; N. side of Frenchman River. Lateral (7) and ventral (8) views. (9) Lateral view of inner whorls.

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PLATE 9

Figures 1-2. **Jeletzkytes plenus** (Meek), Holotype. USNM 364. Pierre Shale, Yellowstone River near Miles City, Montana. Lateral (1) and ventral (2) views of a plaster cast.

Figures 3-4. **Jeletzkytes crassus** (Coryell and Salmon). Holotype. AMNH 24234. Top member of Pierre Formation at Glendive T14N R55E, Dawson Co., Montana. Coll. T. Wasson, 1930. Ventral (3) and lateral (4) views.

Plate 9

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PLATE 10

Figures 1-6. **Jeletzkytes** cf. **brevis** (Meek) ♂

1-2. Photograph of a plaster cast of paratype of "**Jeletzkytes quadrangularis** (Meek)". USNM 365. Pierre Shale, Cheyenne River, S. Dakota. Lateral (1) and ventral (2) views.

3-4. Photograph of a plaster cast of another paratype of "**Jeletzkytes quadrangularis** Meek". USNM 366. Upper Pierre Shale, Yellowstone River, 240 km (150 mi) from mouth, Montana. Ventral (3) and lateral (4) views.

5-6. Photograph of a plaster case of the holotype of "**Jeletzkytes quadrangularis** (Meek)". USNM 366. Same locality and level as above. Lateral (5) and ventral (6) views.

Figures 7-21. **Jeletzkytes** cf. **brevis** (Meek) ♂

7-9. Complete specimen. U.A. 03943 (Ct. 1). Near Ponteix, Saskatchewan. Coll. P.S. Warren. Apertural (7), lateral (8) and ventral (9) views.

10-14. Incomplete specimen. GSC 67101; GSC loc. 10407. Belanger Member. Cypress Hills. Sec. 16, Tp. 3, Rge. 25, W3rd. Coll. G.M. Furnival 1940. 10-11. Ventral (10) and lateral (11) views of outer whorls. 12-14, apertural (12), lateral (13) and ventral (14) views of inner whorl.

15-16. Incomplete specimen. GSC 67103. Same level and locality as for the last. Ventral (15) and lateral (16) views.

17-18. Incomplete specimen. GSC 67100. Same level and locality as for specimen GSC 67101. Lateral (17) and ventral (18) views. This specimen was tentatively assigned to **S. elegans** Tate by Jeletzky (in Cobban and Reeside, 1952, p. 1027).

19-21. Complete specimen GSC 67102. Same level and locality as for specimen GSC 67101. Lateral (19) and ventral (20) views of the inner whorl. Lateral (21) view of the complete specimen.

Figures 22-23. **Scaphites elegans** Tate. Photographs of plaster cast of the holotype GSM 37263 (GSC replica no. 37263). Antrim Chalk; Northern Ireland. Lateral (22) and ventral (23) views.

Plate 10

PLATE 11

Figures 1-21. **Jeletzkytes** cf. **criptonodosus** sp. nov. o

1-3. Complete mature specimen. GSC 67111; GSC loc. 10375. Belanger Member, 0.4 km (1/4 mi) north of junction of Davis Creek and Frenchman River, 183 m (200 yd) east of cabin. Coll. G.M. Furnival, 1940. Lateral (1), apertural (2) and ventral (3) views.

4-6. Complete specimen. GSC 67108; GSC loc. 10437. SW of Milestone. Coll. R. Graham, 1936. Lateral (4), apertural (5) and ventral (6) views.

7-11. Almost complete mature specimen. GSC 67109; GSC loc. 10398. West of Dam Coulée, about 1.6 km (1 mi) W of Highway 21, south side of Cypress Lake, Saskatchewan. Coll. G.M. Furnival, 1940. 9-11, apertural, ventral and lateral views; 7-8, ventral view X1.4 and lateral view X2.

12-14. Complete specimen. GSC 67106; GSC loc. 10437. SW of Milestone, SE 1/4, Tp. 10, Rge. 20, W2nd, Saskatchewan. Coll. R. Graham, 1936. Lateral (12), apertural (13) and ventral (14) views.

15-16. Almost complete specimen. GSC 67107a, GSC loc. 10374. Sed. 14, Tp. 6, Rge. 25, W3rd., Saskatchewan. Lateral (15) and ventral (16) views.

17. Incomplete and partially deformed specimen. GSC 67110; GSC loc. 16326. Ponteix, Saskatchewan. Coll. P.S. Warren, 1930. Lateral view.

18-21. Almost complete specimen. U.A. 7071. Notukeu Creek, near Cadillac, Saskatchewan. Coll. P.S. Warren, 1928. 18-19, lateral and apertural views of inner whorl; 20-21, lateral and ventral view of the terminal whorl.

Figures 22-23. **Scaphites pungens** Binkhorst. Holotype, photograph of a plaster cast, MNHUB C. 606b. Limbourg. Ventral (22) and lateral (23) views.

Plate 11

PLATE 12

Figures 1-6. **Rhaeboceras halli** (Meek).

1-3. Holotype. Photograph of a plaster cast, USNM 384. Missouri River, 241.4 km (150 mi) above mouth of Milk River. Montana. Lateral (1), apertural (2) and ventral (3) views.

4-6. Specimen with incomplete body chamber. GSC 5370; GSC loc. 97995. Dirt Hills, Saskatchewan. Coll. A. Mowat, 1892. Apertural (4) and two lateral (5, 6) views.

Plate 12

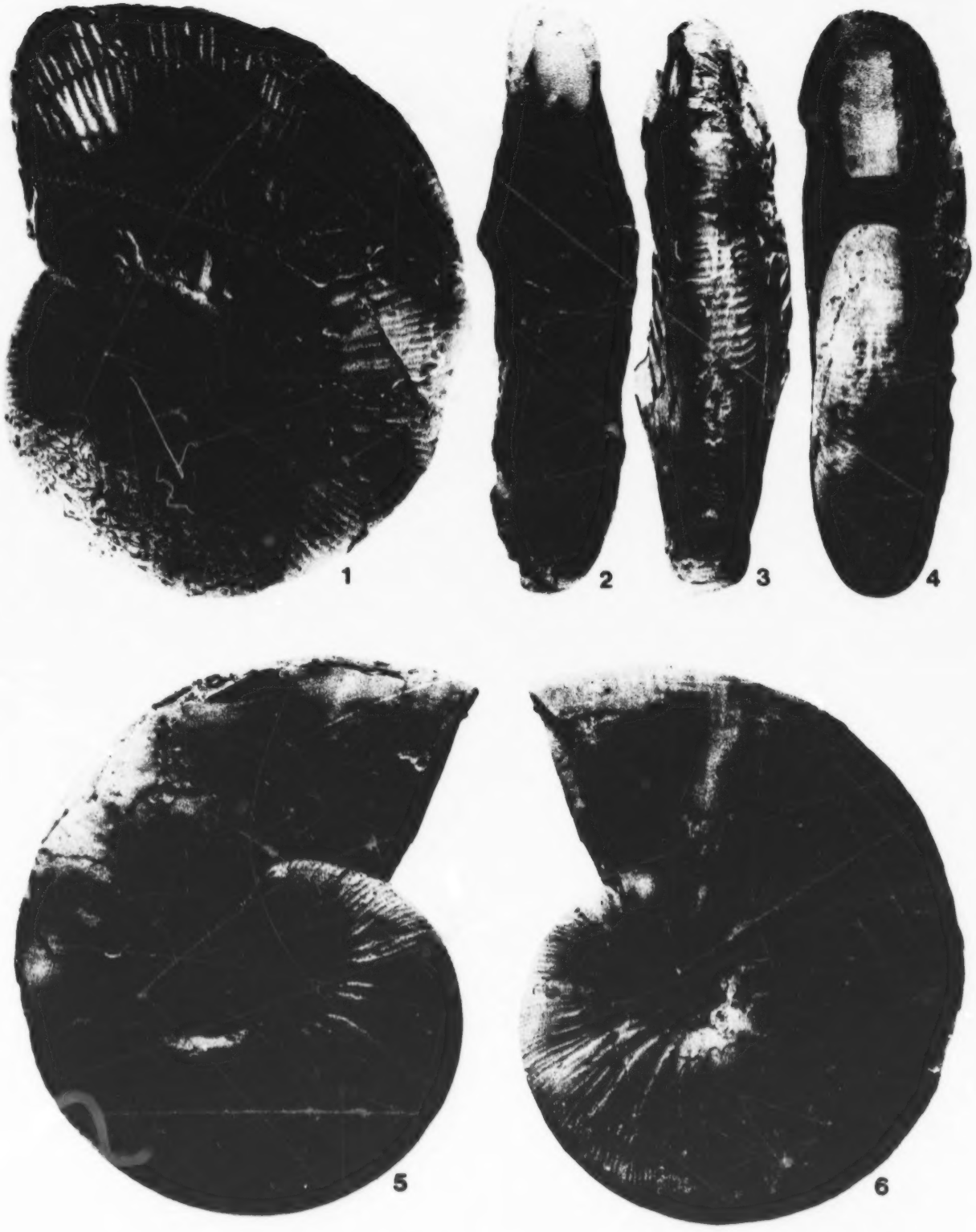

PLATE 13

Figures 1-4. **Rhaeboceras halli** (Meek). Holotype of "**Ammonites opalus** Owen", FM 6377. Great Bend of Missouri River. Gurley Collection. Two lateral (1, 2), apertural (3) and ventral (4) views.

Figures 5-7. **Rhaeboceras albertense** (Warren). Lectotype, U.A. 349. Steveville, Alberta. Coll. W.E. Cutler. Lateral (5), apertural (6) and ventral (7) views.

Figure 8. **Rhaeboceras halli** (Meek). Incomplete and partially distorted specimen. U.A. 771. Sec. 33, Tp. 1, Rge. 22, W4th, Alta. Coll. J.S. Irwin, 1930. Lateral view.

Figures 9-10. **Rhaeboceras aff. halli** (Meek). GSC 67112. Exact locality unknown. Cypress Hills. Coll. G.M. Furnival. A pathological specimen (note the healed scar in Fig. 10). Ventral (9) and lateral (10) views.

Plate 13

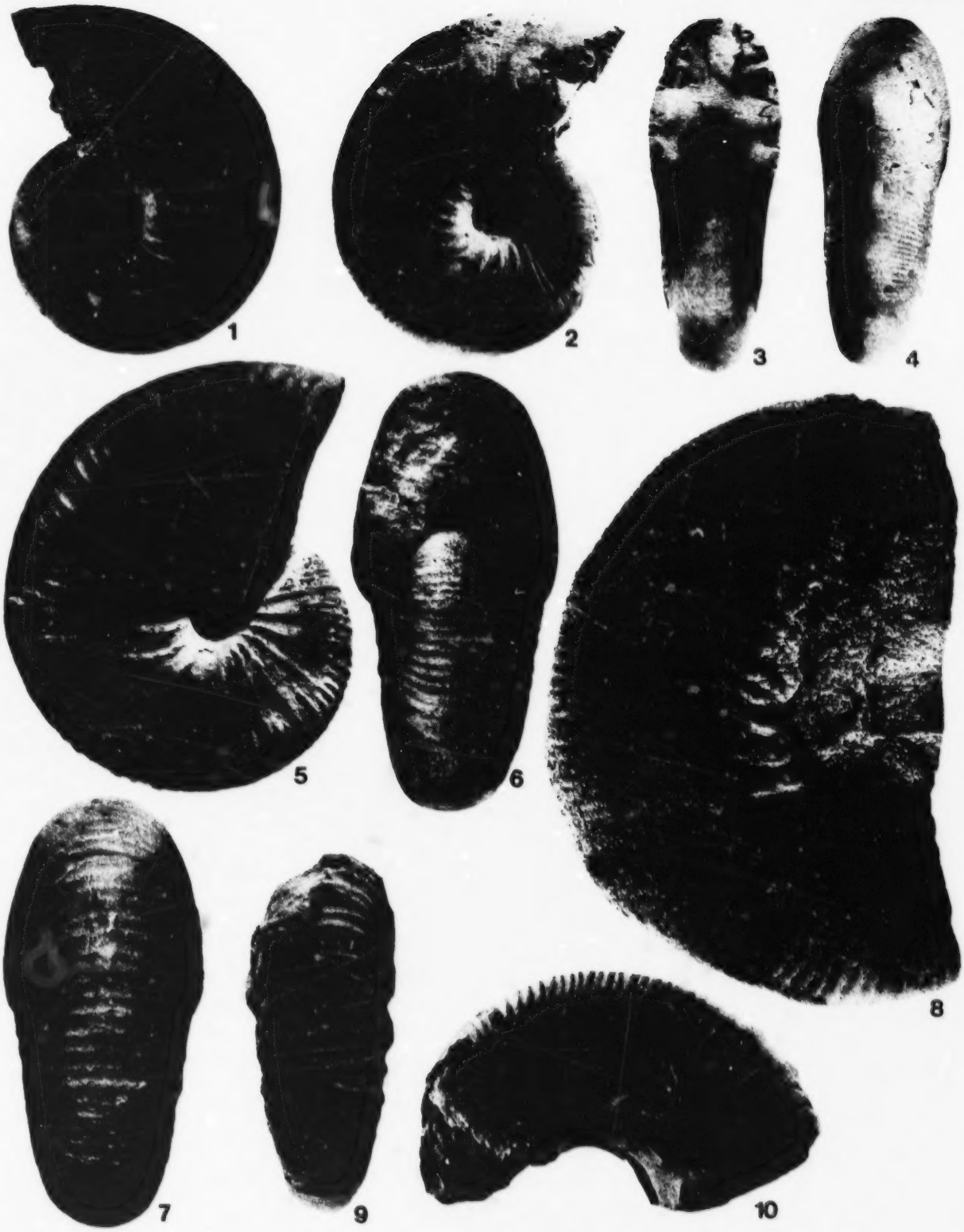

PLATE 14

Figures 1-11. **Rhaeboceras albertense** (Warren)

1-5. Almost complete adult phragmocone with part of body chamber. GSC 67117; GSC loc. 16396. c. 152.5 m (500 ft) above base of Bearpaw Formation, Manyberries section, Alta. Coll. R.W. Landes. (1) lateral view of outer whorls; (2) ventral and (3) lateral views of inner whorls; (4) lateral and (5) ventral views of intermediate whorls.

6-11. Complete phragmocone. GSC 67118. Same level and locality as above. 6-7, Apertural and lateral views of innermost whorls; 8-10, Ventral, apertural and lateral views of complete specimen; 11, Cross-section, X2.

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PLATE 15

Figures 1-8. **Rhaeboceras albertense** (Warren)

1-5. Incomplete specimen. GSC 67116; GSC loc. 97998. Travers Reservoir near Vulcan, at opposite end of lake from Little Bow Park. Coll. P. James, 1980. (1) Lateral view of complete specimen; (2) The same with the outer whorl removed; (3) Lateral, (4) Apertural and (5) ventral views of innermost whorls.

6. Phragmocone whorls of specimen figured in Plate 16. GSC 67114; GSC loc. 16313. Lateral view.

7-8. Incomplete specimen. U.A. 154. Lethbridge, Alta. Lateral (7) view and cross-section (8).

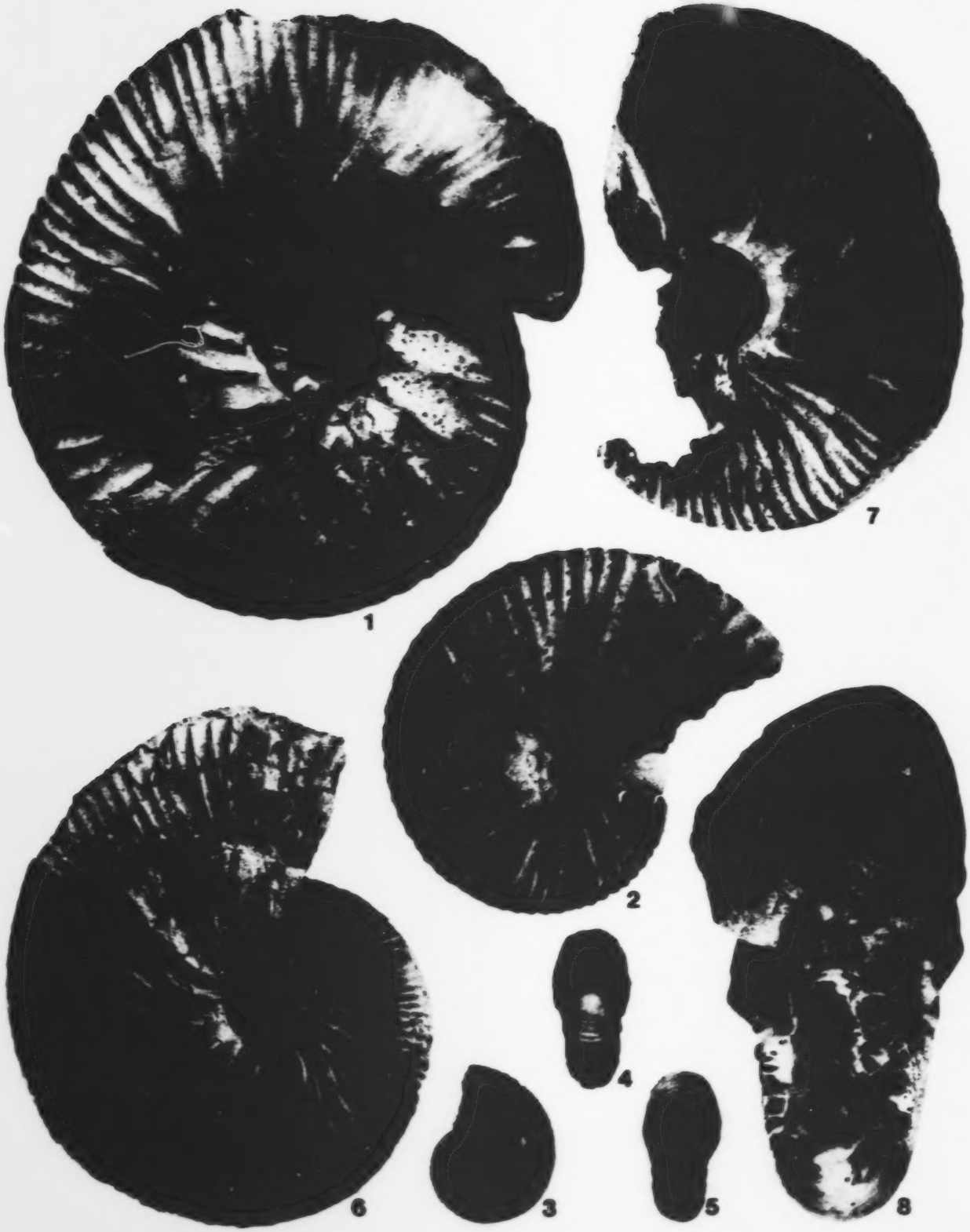
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PLATE 16

Figures 1-2. **Rhaeboceras albertense** (Warren). Almost complete, adult specimen. GSC 67114; GSC loc. 16313, 152.5-183.0 m (500-600 ft) below top of Bearpaw Formation, McShane Creek, S. 25, Tp. 9, Rge. 27, W3rd, Cypress Hills, Saskatchewan. Coll. G.M. Furnival, 1941. Lateral (2) and apertural (1) views.

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PLATE 17

Figures 1-9. **Rhaeboceras albertense** (Warren).

1-2. Almost complete phragmocone and part of body chamber. GSC 67115; GSC loc. 16313. Same locality and level as for specimen GSC 67114 (Pl. 16). (1) Lateral view of complete specimen; (2) The same with body chamber removed.

3-4. Complete adult specimen. GSC 5338; GSC loc. 98000. White Mud River. Coll. R.G. McConnell, 1884. Apertural (3) and lateral (4) views.

5-6. Paralectotype. U.A. 371. Steveville, Alta. Coll. S. Davies. Lateral (5) and ventral (6) views.

7-9. Almost complete adult specimen. GSC 67119; GSC loc. 16334. Frenchman River, Saskatchewan. Coll. F.H. McLearn 1928. (7-8) Ventral and lateral views of phragmocone with body chamber removed; (9) Lateral view of complete specimen.

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PLATE 18

Figures 1-5. **Rhaeboceras albertense** (Warren)

1-2. Almost complete, slightly crushed, specimen. U.A. 1108. Upper beds of Pale Beds. Lost River, Tp. 1, Rge. 4, W4th; c. 3.2 km (2 mi) north of 49th parallel, Silver Smoliak. Coll. Dr. Moore. Lateral (1) and apertural (2) views.

3-5. The original of "**Rhaeboceras halli** Meek" of Williams, 1930, GSC 67113; GSC loc. 97997. South branch of Boxelder Creek, Sec. 30, Tp. 10, Rge. 29, W3rd, Saskatchewan. Coll. W.S. Dyer. Ventral (3), lateral (4) and apertural (5) views.

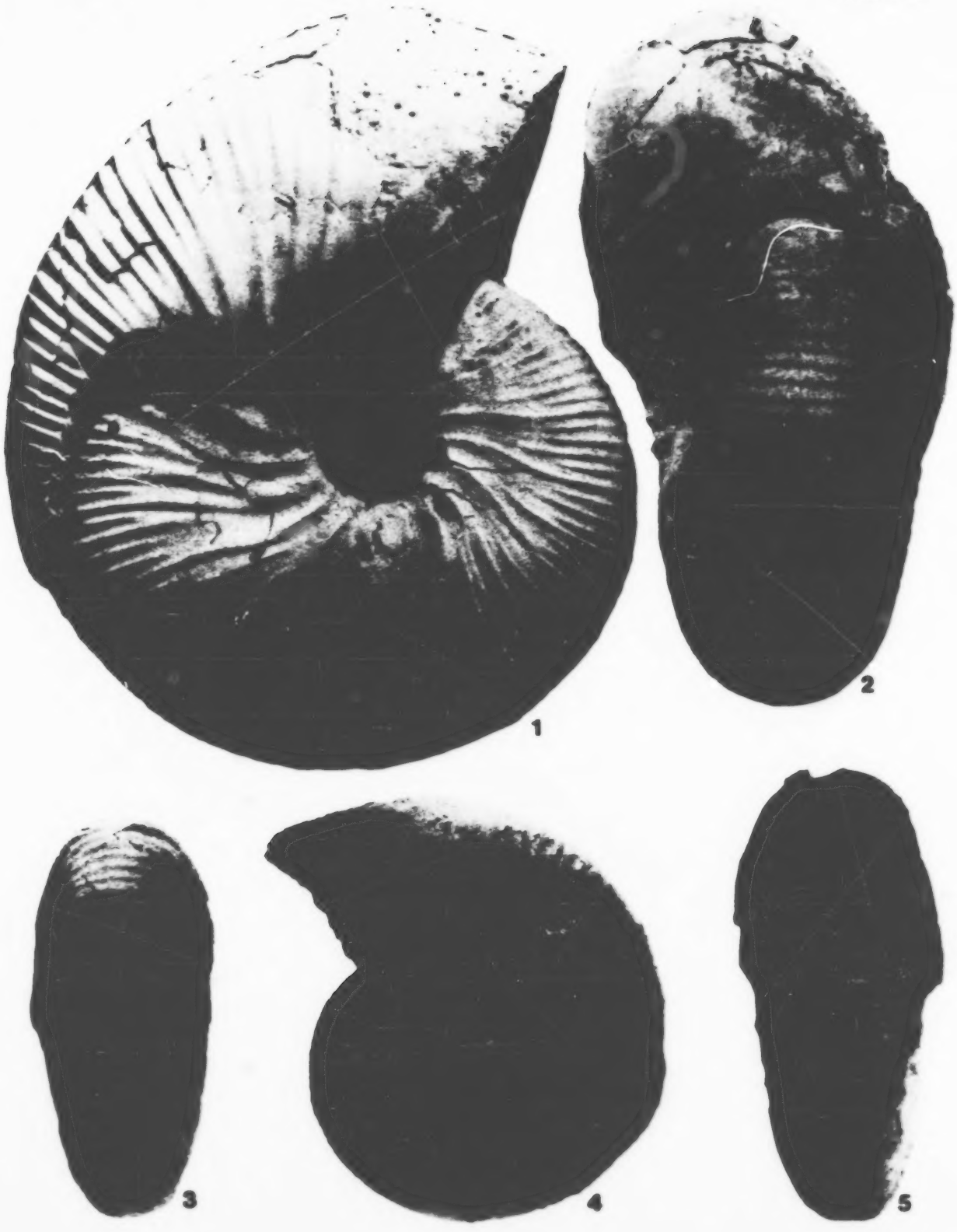
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PLATE 19

Figures 1-4. **Rhaeboceras subglobosus** (Whiteaves)

1-2. Lectotype. GSC 5339; GSC loc. 97992. Wood (Old Wives) Creek, Tp. 10, Rge. 11, W3rd, Saskatchewan. Coll. R.G. McConnell 1884. Lateral (1) and apertural (2) views.

3-4. "**Rhaeboceras whiteavesi** Landes". Holotype, GSC 9367. Complete phragmocone with the early part of body chamber. GSC loc. 98002, Blood Reserve Sandstone, Pothole Creek, SW 1/4, Sec. 34, Tp. 2, Rge. 22, W4th. Coll. R.W. Landes. Lateral (3) and ventral (4) views.

Plate 19

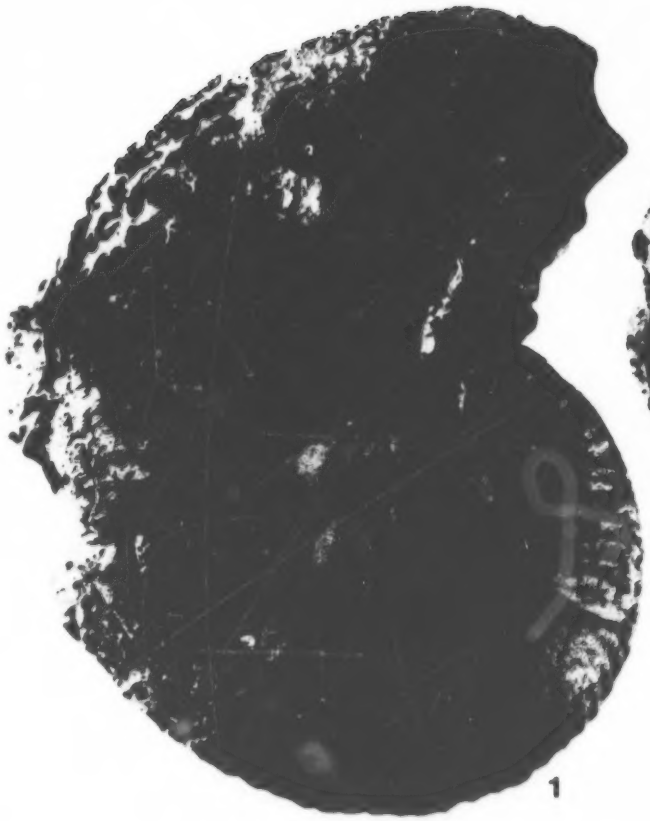

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PLATE 20

Figures 1-3. **Rhaeboceras subglobosus** (Whiteaves)

1. Paratype of "**Rhaeboceras whiteavesi** Landes", GSC 67120; GSC loc. 16396. About 45.7 m (150 ft) above Bentonite no. 8, Manyberries Section, Cypress Hills, Alta. Coll. R.W. Landes. Lateral view (see Pl. 23, figs. 1-3).

2. Inner whorls of the paralectotype. GSC 5371; GSC loc. 98001. East branch of the Poplar River, on the 49th parallel. Coll. G.M. Dawson. Lateral view.

3. Fragment of specimen exposing cross section of several phragmocone whorls. GSC 67123; GSC loc. 16337. Frenchman River, south bank, about 1.6 km (1 mi) below McGuiness Ranch. Coll. F.H. McLearn, 1928.

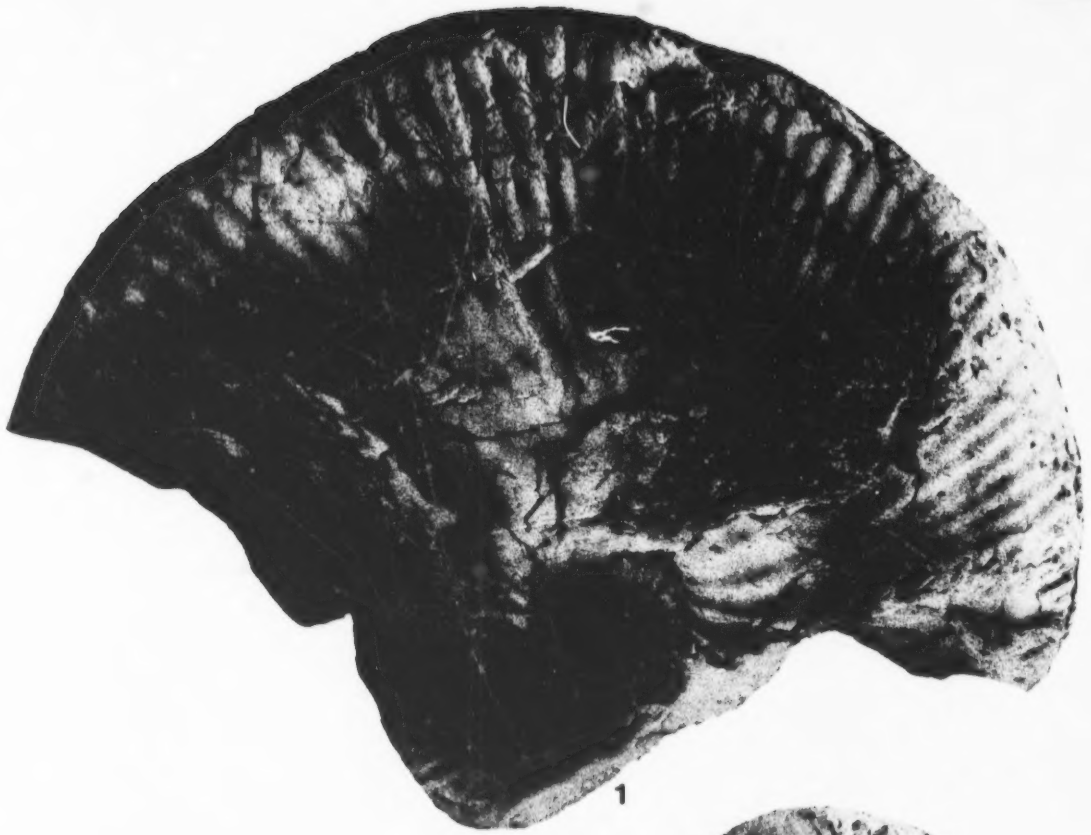

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PLATE 21

Figure 1. **Rhaeboceras subglobosus** (Whiteaves). Fragment of large whorl. GSC 67121; GSC loc. 16396. Coll. R.G. McConnell, 1884. Ventral view, X0.75.

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PLATE 22

Figure 1. **Rhaeboceras subglobosus** (Whiteaves). Partially crushed phragmocone. GSC 67122; GSC loc. 16396. Manyberries section, Alta. Coll. R.W. Landes. Lateral view.

Figures 2-4. **Jeletzkytes** cf. **crassus** (Coryell and Salmon). The phragmocone included in **R. subglobosus** by Whiteaves, 1885. GSC 5339. Old Wives Creek, Coll. R.G. McConnell, 1884. Lateral (2), ventral (3) and apertural (4) views.

Plate 22

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PLATE 23

Figures 1-3. **Rhaeboceras subglobosus** (Whiteaves). Phragmocone whorls of the paratype of "**Rhaeboceras whiteavesi** Landes". GSC 67120; GSC loc. 16396. Manyberries section, Alta. Coll. R.W. Landes. Lateral (1), ventral (2) and apertural (3) views (see Pl. 20, fig. 1).

Figures 4-22. **Ponteixites robustus** Warren

4-7. Holotype. GSC 8738. Notukeu Creek, near Ponteix, 4.8 km (3 mi) west of Tilney, Saskatchewan. Two lateral (4, 5), apertural (6) and ventral (7) views.

8-9. Almost complete specimen. GSC 21846; GSC loc. 98004. Headwaters of Moose River or Great Bend Creek. Tp. 2, Rge. 20, W2nd, Saskatchewan. Lateral (8) and ventral (9) views.

10-15. Paratype. GSC 8739. Notukeu Creek, near Ponteix, 4.8 km (3 mi) west of Tilney. Coll. F.H. McLearn. 10-12. Lateral (10), ventral (11) and apertural (12) views; 13-15, Same views, X2.

16-18. Almost complete adult. GSC 67124; GSC loc. 10395. About 28.0-28.1 m (92-93 ft) below top of Bearpaw Formation, NW side of Cypress Lake, Sec. 14, Tp. 6, Rge. 27, W3rd, Saskatchewan. Coll. G.M. Furnival, 1940. Apertural (16), ventral (17) and lateral (18) views.

19-22. Incomplete phragmocone. GSC 67128; GSC loc. 17882, ?Frenchman River, Saskatchewan. Coll. P.S. Warren, 1928. 19-20. Lateral (19) and ventral (20) views; 21-22, Same views, X2.

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PLATE 24

Figures 1-9. **Ponteixites robustus** Warren

1-4. Incomplete phragmocone. GSC 67126; GSC loc. 16327. West of Tilney, near Ponteix. Coll. P.S. Warren. 1-2. Lateral (1) and ventral (2) views; 3-4, Same views, X2.

5-6. Incomplete phragmocone. GSC 67125. Same locality as for specimen GSC no. 67126. Lateral (5) and ventral (6) views.

7-9. Incomplete specimen with part of the body chamber. GSC 67127. Same locality as for specimen GSC 67126. Lateral (7), ventral (8) and apertural (9) views, X2.

Figures 10-43. **Ponteixites gracilis** Warren

10-11. Incomplete specimen with part of body chamber. GSC 67132; GSC loc. 16326. Ponteix, Saskatchewan. Lateral (10) and ventral (11) views, X2.

12-13. Incomplete phragmocone. GSC 67133. Same locality as for specimen GSC 67132. Lateral (12) and ventral (13) views, X2.

14-19. Holotype, GSC 8740. From 4.8 km (3 mi) west of Tilney, Saskatchewan. Coll. P.S. Warren, 1930. 14-16. Lateral (14), apertural (15) and ventral (16) views; 17-19. Same views, X2.

20-25. Paratype, GSC 8741b. Same locality as for the specimen GSC 8740 (holotype). 20-22. Lateral (20), ventral (21) and apertural (22) views; (23) Lateral view of the other side, X2; (24) Ventral view, X2; (25) Apertural view, X2.

26-31. Paratype, GSC 8741a. Same locality as for the specimen GSC 8740 (holotype). 26-28. Lateral (26), apertural (27) and ventral (28) views; 29-31, Same views, X2.

32-35. Almost complete specimen. GSC 67129; GSC loc. 17882. ?Frenchman River, Saskatchewan. Coll. P.S. Warren. 34-35. Lateral (34), and ventral (35) views, X2; 32-33, Same views, X1.

36-41. Incomplete phragmocone. GSC 67130; GSC loc. 10437. SE 1/4, S. 23, Tp. 10, Rge. 20, W2nd, Saskatchewan. Coll. P. Graham, 1936. 36-38. Lateral view (36), cross-section (37) and ventral view (38), X2; 39-41, Same views, natural size.

42-43. Incomplete phragmocone. GSC 67131; GSC loc. 16326. Ponteix, Saskatchewan. Lateral (42) and transverse section (43) views, X2.

44-46. **Ponteixites**(?) sp. nov., GSC 67134. Incomplete phragmocone from Berry Creek, Sec. 11, Tp. 27, Rge. 12, W4th. Coll. L.S. Russell, GSC loc. 16457. Lateral (44), apertural (45), and ventral (46) views.

47-49. **Ponteixites**(?) sp. nov. GSC 67135. Incomplete phragmocone from same locality as above. Lateral (47), ventral (48) and cross-sectional (49) views.

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PLATE 25

Figures 1-3. **Baculites cuneatus** Cobban; GSC 5357. South Saskatchewan River, opposite Swift Current Creek, Saskatchewan (Coll. R.G. McConnell, 1882, GSC loc. 97991). Lateral (1), dorsal (2) and cross sectional (3) views.

4-6. **Baculites eliasi** Cobban, GSC 21848. Dirt Hills, Saskatchewan (Coll. A. Mowat, 1892; GSC loc. 97995). Lateral (4), dorsal (5) and cross-sectional (6) views.

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PLATE 26

Figures 1-2. **Baculites compressus robinsoni** Cobban. Holotype, GSC 9070; GSC loc. 98864. About 45.7 m (150 ft) above base of Bearpaw Formation, south side of Little Boxelder Coulée, Sec. 16, Tp. 11, Rge. 29, W3rd (Coll. G.M. Furnival). Lateral (1) and cross-sectional (2) views.

3-5. **Baculites reesidei** Elias, GSC 67137; GSC loc. 16321. Cypress Hills, NW 1/4, Sec. 18, Tp. 9, Rge. 28, W3rd, Saskatchewan (Coll. G.M. Furnival). Lateral (3), ventral (4) and cross-sectional (5) views.

6-10. **Baculites baculus** Meek and Hayden

6-7. Incomplete specimen, GSC 67138; GSC loc. 10377. From Belanger Member, 0.4 km (1/4 mi) north of junction of Davis Creek and Frenchman River, 182.8 m (200 yd) east of cabin (Coll. G.M. Furnival). Cross-sectional (6) and lateral (7) views.

8-10. Incomplete specimen, GSC 67139; GSC loc. 10437. From SW of Milestone, SE 1/4, Tp. 10, Rge. 20, W2nd, Saskatchewan (Coll. R. Graham, 1936). Lateral (8), ventral (9) and cross-sectional (10) views.

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